THE

ONTARIO WATER RESOURCES

COMMISSION

# OUTFALL SURVEY

# of the

# HUMBER RIVER AND TRIBUTARIES

# within the

# MUNICIPALITY OF METROPOLITAN TORONTO



1972

# REPORT ON
# AN OUTFALL SURVEY
# OF THE
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# WITHIN
# THE MUNICIPALITY OF METROPOLITAN TORONTO

District Engineers Branch
Division of Sanitary Engineering

February 1972

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SUMMARY

This report on the Humber River and its tributaries is the third in a series of outfall surveys of the major watercourses within the boundaries of Metropolitan Toronto. The purpose of this work is to locate and sample, if possible, all sources or potential sources of significant flow to the river.

The river and tributaries along with the location of the outfalls are shown on Figures 1 through 4. Appendices I to IV give a brief description of the outfalls including their municipalites and Tables I to IV present the analytical results of the samples collected. Tables V and VI show the yearly average results of samples taken at the mouth of the Humber and at Clairville Dam Reservoir. These data are available through the efforts of the Metropolitan Toronto and Region Conservation Authority, who collect the samples, the Ontario Water Resources Commission laboratory, who perform the analyses, and the Water Quality Surveys Branch of the Division of Sanitary Engineering, who maintain the results.

Field work was conducted during two sessions. In July, 1971, staff of the Department of Health for the Borough of North York and this writer sampled and recorded the outfalls along the Main Branch of the Humber River

from Steeles Avenue to the boundary of the Borough of York. During October, 1971, members of the District Engineers Branch covered the remainder of the river and its tributaries. Sample analysis was done at the Ontario Water Resources Commission laboratory for both sessions.

There is no doubt that some outfalls were unavoidably overlooked, however 328 outfalls were located and recorded and 136 had sufficient flow to collect samples.

RECOMMENDATIONS

The appropriate municipality should now take action as suggested in the report, i.e.,

1. Investigate and correct the cause or causes of the poor quality of effluent from the points noted on page 11.
2. Establish the quality of effluent from the other sample points within the municipality and initiate corrective measures to bring the quality of these effluents to within the limits established by Metropolitan Toronto By-Law 2520.

## INTRODUCTION

The Ontario Water Resources Commission set out to survey each of the five major watercourses within Metropolitan Toronto, and produce for each a plan or plans showing all sources or potential sources of flow, and determine the quality of those flows. The outfall survey of the Humber River and tributaries is the third report of the series having been preceded by the Highland Creek Survey and the Don River Survey.

Following the routine established in the past,the work consisted of one sampling run on the Humber River and its main tributaries. A single sample, however, cannot be used to determine the quality of an outfall under all conditions. In most instances, therefore, the analyses presented in this report should not be used as a basis for action until they have been substantiated by additional results. However, for some samples the results were sufficiently adverse to warrant immediate remedial measures and these have been pointed out.

A municipality is responsible for the quality of effluent that it discharges from its sewers to the watercourses. Having been supplied with these preliminary results the municipalities can now initiate the appropriate action necessary to bring the effluents up to an acceptable quality.

Field work for this survey was done on July 20 and 21, 1971, October 5, 6 and 7, 1971 and October 13, 1971, under primarily stable weather conditions. Appendix V contains meteorological data from the Federal Department of Transport on the days the field work took place. The data given is an interpolation of the information collected at Toronto International Airport and the downtown station. The quality of discharge is often greatly affected by the weather and sample comparison should be made only when weather conditions are similar.

In the four plans accompanying this report, the Main Humber, West Humber and Black Creek are shown along with the approximate location of the outfalls. From these plans and the location descriptions provided in Appendices I - IV, the municipalities should be able to locate the sample points in the field. Tables I to IV present the analytical results of the samples collected.

GENERAL

1. Watershed Data

The Humber River watershed drains an area of 345 square miles of which approximately 40 square miles are in Metropolitan Toronto. The two principal tributaries within the Metro boundary are the West Humber and Black Creek.

2. Sewage Treatment Plants

Within the boundaries of Metropolitan Toronto there are no longer any sewage treatment plants discharging to the Humber or any of its tributaries. North of Metro there are three sewage systems presently discharging. The Village of Bolton plant discharges to the Main Branch, as does the Kleinburg plant. The package sewage treatment plant at the Shell Service Centre on Highway 400 at the King Side Road discharges to the East Humber.

3. Combined Sewers

The Humber River borders the Boroughs of North York, Etobicoke, York and the City of Toronto. With the exception of North York, each municipality has part of its sewer system in the form of combined sewers.

The Borough of York is primarily on combined sewers and is in the midst of a 25-year program of sewer

separation. The 84" relief sewer from Hillary Avenue at Keele Street to Black Creek is an example of a link between the combined sewers and a watercourse. Adjacent to Black Creek north of the outlet of the sewer, a storm flow equalization tank, of approximately 2,000,000 gallons capacity is presently under construction with completion scheduled for April, 1972. This sewer and tank will eventually handle storm flow only.

A very small portion (some 200 homes of approximately 48,000) of Etobicoke is on combined sewers (i.e. roof leaders and footing drains connected to sanitary sewers. This problem area is primarily in the Lakeshore area and any sanitary sewage discharged with storm flow would go to the lake. The borough has had corrections made to some 500 of the original 700 homes known to be creating these problems.

The City of Toronto's sewage collection system is the most extensive of all the municipalities within Metropolitan Toronto. It was constructed as a combined system and during wet weather the relief facilities permit discharges to various watercourses. One of these outfalls discharges to the Humber. The City is in its eighth year of a 25-year program of sewer separation.

4. Water Quality

A regular sampling program has been in existence at the mouth of the Humber and at the Clairville Dam Reservoir

for some years. The results from the past 7 years are presented in Tables V and VI.

5. Photographs

The following photographs show what might be encountered along the Humber River and Black Creek. All the pictures were taken within the Metropolitan Toronto boundary.

This outfall enters a small ravine which opens onto the West Branch of the Humber at the end of Lakeland Drive. Flow was insufficient for sampling however, evidence of an oily material was found on the concrete apron and the rock below.

Scenes that can be found along watercourses which flow through urbanized areas.

This outfall pipe empties into Black Creek north of Wilson Avenue. The flow was insufficient for sampling.

Outfall just upstream from St. Phillips Road Bridge.

| | |
|---|---|
| Size | - 12" CMP |
| Flow | - 1/6 to 1/3 full - continuous |
| BOD | - 95 ppm |
| SS | - 28 ppm |
| Fecal | - 8,000 |
| Total Coliforms | - 540,000 |

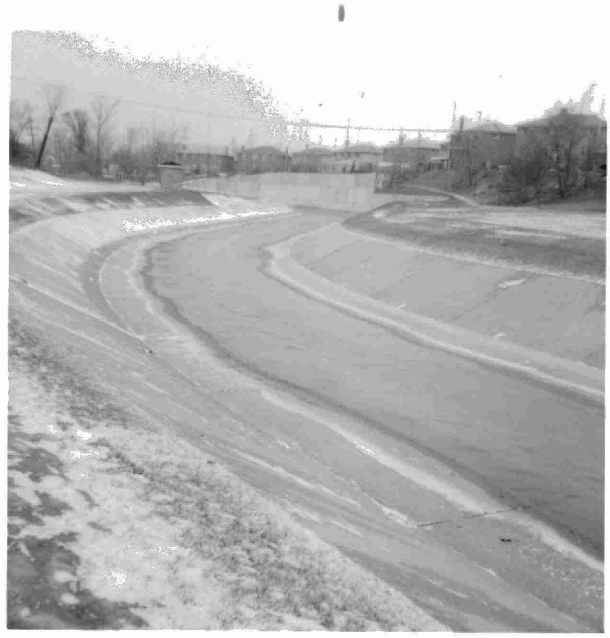
The channel from this outfall had been recently cleaned out. The water was stagnant.

| | |
|---|---|
| BOD | - 8.5 ppm |
| SS | - 10 ppm |
| Fecal | - 500 |
| Total Coliform | - 670,000 |


Black Creek flowing south from Weston Road

Metropolitan Toronto and Region Conservation Authority flood control and erosion prevention.

Black Creek just upstream from Scarlett Road in Smythe Park.



One of many flow regulating dams on Main Branch of the Humber River, located south of Dundas Street. Sampling point upstream found a BOD of 2.5, SS of 25, Fecal Coliforms 330 and Total Coliforms 9,200.

A large portion of the river bank south of Highway 401 to Lake Ontario has been built-up with concrete block, stone mansonry (the top of some in foreground of this picture) or gabions for flood control and erosion prevention.

## ANALYTICAL RESULTS

### 1. General

At each sampling point a chemical and a bacteriological sample were taken. Chemical analyses requested were 5-Day BOD, total, suspended and dissolved solids and phenols. At points where it was felt necessary, additional analyses were asked for, ie., ABS (Anionic Detergents), iron, etc. For the bacteriological samples total and fecal coliform determinations were requested.

This report uses the standards of the previous outfall survey, the Metropolitan Toronto By-Law 2520 which regulates the discharge of sewage and land drainage in the Metropolitan Area. The criteria established for waters being discharged to a storm sewer or watercourse are:

| | Metropolitan Toronto By-Law 2520 |
|---|---|
| BOD | 20 mg/1 |
| Suspended Solids | 30 mg/1 |
| Phenols | 0.04 mg/1 |
| Total Coliform Bacteria | 2400 per 100 ml |

Those samples conforming to all four criteria have been called acceptable while all others have been denoted non-acceptable.

### 2. Humber River Main Branch

The main branch of the Humber River enters

Metropolitan Toronto west of Islington Avenue and flows in a southerly direction to the point where it enters Lake Ontario just west of the South Kingsway. The river forms the entire east boundary of the Borough of Etobicoke and acts as the western boundaries of the City of Toronto, and the Boroughs of York and North York.

Along the course of the river are located 120 points of discharge or potential discharge as shown on Figures 1 and 2 and listed on Appendix I. Seventy-eight of the 120 points had sufficient flow to permit sampling and the results are shown on Table I.

Fifteen of the 78 were of acceptable quality. Eight of the samples exceeded the criteria for BOD, 16 for suspended solids, 59 for total coliform bacteria, three for phenols and one had a high concentration of detergent.

Sampling took place during July and October and on each occasion no appreciable quantity of precipitation fell.

3. Humber River - West Branch

The West Branch of the Humber River enters Metropolitan Toronto at the Clairville Reservoir and flows in a south-easterly direction to join the Main Branch west of the end of Sheppard Avenue West.

A total of 29 outfalls were accounted for along the West Branch and are listed on Appendix II and shown on Figure 2. The analytical results of Table II indicate only one outfall of acceptable quality out of the eight points samples. The rest of the outfalls were unacceptable for the following reasons: seven for total coliform bacteria, three for suspended solids and three for BOD.

Field work on this branch of the river was done primarily in dry weather.

4. Black Creek

Black Creek is a large tributary to the Humber River. The creek enters Metropolitan Toronto just east of the Jane Street and Steeles Avenue intersection and flows generally in a southerly direction to join the Main Branch at the Lambton Golf & Country Club north of Dundas Street.

One hundred and seventy-nine points of discharge or possible discharge are listed on Appendix III and shown on Figures 3 and 4. Fifty of the total number of outfalls had sufficient flow to enable sampling and the analytical results are presented in Tables III. Nine of the 50 points sampled were of acceptable quality meeting

all four criteria. The remaining samples were not acceptable for the following reasons: 38 for total coliform bacteria, 12 for suspended solids, and eight for BOD.

Field work on Black Creek was done under primarily dry weather conditions.

5. Watercourse Samples

The Humber River Basin has been monitored routinely by the OWRC with the co-operation of the Metropolitan Toronto Region Conservation Authority for the past seven years. At the present time, water samples are collected monthly from 10 stations along the watercourse, two of which are within the boundaries of the Municipality of Metropolitan Toronto. During the outfall survey, 21 additional locations were sampled to obtain further information on the water quality of Humber River and its tributaries lying within the Metro boundaries. The station descriptions and analytical results for these samples are presented in Appendix IV and Table IV, respectively. Locations of the stations are shown on Figures 1 to 4 . Annual summaries of data for the two monitoring stations are presented in Tables 5 and 6.

Both the routine monitoring data and the samples collected during the outfall survey indicate water quality deterioration in the Humber River Basin within the Metro boundaries. The main impairments included bacteriological

contamination, increase in suspended solids, chlorides and phenolic compounds and occasional reduction in dissolved oxygen levels. Examination of the monitoring data for the station near the mouth of the Humber River did not display any definite patterns, with exception of chlorides which were usually the highest during winter months probably because of the runoff from road salting operations.

## 6. Discussion of Results

Although, as stated previously, the results of one run of samples cannot be taken as representative for each point it is felt that a number of points are of such adverse quality that an investigation should be carried out as soon as possible in the appropriate municipalities. Those sample points are listed below under their municipalities:

| | | |
|---|---|---|
| Borough of Etobicoke | - | HM-16, HM-47, HM-51, HM-66, HM-72, HW-15, HW-16, HW-20 |
| Borough of North York | - | HM-106, HM-120, BC-64, BC-70, BC-102, BC-159, BC-162, BC-166, BC-167 |
| Borough of York | - | HM-45, HM-58, HM-73, BC-45, BC-3, BC-9, BC-19, BC-21, BC-32 |

From the plans and descriptions it should be possible for the municipalities to relate the various sampling locations to the discharge points from their sewer systems. They should then proceed upstream through the

systems to isolate and rectify the cause or causes of these sample results.

The remainder of the unacceptable sample points should be related to the municipal sewer systems discharge points and resampled to establish their quality with some degree of certainty. Points found to be consistently of unsatisfactory quality should be investigated in the same manner as previously mentioned.

The assistance of the Ontario Water Resources Commission is available in locating sampling points.

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TABLE I

ANALYTICAL RESULTS - HUMBER RIVER - MAIN BRANCH

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) Total | Dissolved | Suspended | COLIFORMS Fecal | Total | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| HM-2 | Oct. 13 | 1.6 | 650 | 640 | 10 | L10 | 12,000 | 10 | - |
| HM-3 | Oct. 13 | 6.0 | 1060 | 1055 | 5 | 40 | 15,000 | 8 | - |
| HM-6 | Oct. 13 | 3.0 | 530 | 520 | 10 | 30 | 11,300 | 12 | - |
| HM-7 | Oct. 13 | 18.0 | 690 | 650 | 40 | 10 | 4,000 | 12 | - |
| HM-9 | Oct. 13 | 3.0 | 330 | 325 | 5 | 50 | 24,000 | 6 | - |
| HM-10 | Oct. 13 | 4.0 | 1410 | 1405 | 5 | L1000 | 26,000 | 8 | - |
| HM-14 | Oct. 13 | 3.5 | 920 | 890 | 30 | 260 | 79,000 | 40 | - |
| HM-15 | Oct. 13 | 9.0 | 1240 | 1130 | 110 | 100 | 16,000 | 25 | - |
| HM-16 | Oct. 13 | 5.0 | 1300 | 1280 | 20 | 40,000 | 207,000 | 10 | 1.3 |
| HM-20 | Oct. 13 | 1.2 | 1530 | 1520 | 10 | 40 | 3,500 | 0 | - |
| HM-21 | Oct. 13 | 4.0 | - | - | 5 | G15,000 | G15,000 | 4 | - |
| HM-22 | Oct. 13 | 70.0 | - | - | 60 | G15,000 | G15,000 | 8 | - |
| HM-25 | Oct. 13 | 1.0 | 890 | 885 | 5 | 430 | 19,100 | - | - |

TABLE I - (Cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| HM-28 | Oct. 7 | 0.8 | 1000 | 995 | 5 | L10 | 2,200 | 2 | - |
| HM-31 | Oct. 7 | 1.0 | - | - | 5 | 3,400 | 10,100 | 2 | - |
| HM-35 | Oct. 7 | 2.5 | - | - | 5 | 500 | 6,200 | 2 | - |
| HM-37 | Oct. 6 | 2.0 | - | - | 10 | 120 | 26,500 | 2 | - |
| HM-40 | Oct. 6 | 1.2 | - | - | 35 | 10 | 4,000 | 6 | - |
| HM-41 | Oct. 6 | 1.2 | - | - | 15 | 570 | 11,000 | 2 | - |
| HM-42 | Oct. 6 | 1.4 | - | - | 15 | 290 | 11,900 | 2 | - |
| HM-43 | Oct. 6 | 5.0 | - | - | 30 | L10 | L10 | 2 | - |
| HM-44 | Oct. 6 | 1.2 | - | - | 5 | 560 | 16,000 | 2 | - |
| HM-45 | Oct. 6 | 6.0 | - | - | 15 | 14,000 | 2,100,000 | 4 | - |
| HM-46 | Oct. 6 | 3.0 | - | - | 100 | 500 | 16,000 | 4 | - |
| HM-47 | Oct. 6 | 6.0 | - | - | 600 | L10 | L10 | 40 | - |
| HM-48 | Oct. 6 | 3.0 | - | - | 25 | 2,300 | 17,000 | 4 | - |
| HM-49 | Oct. 6 | - | - | - | - | 130 | 8,200 | - | - |
| HM-51 | Oct. 6 | 48.0 | - | - | 780 | 700 | 137,000 | 16 | - |

TABLE I - (Cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| HM-52 | Oct. 6 | 2.5 | - | - | 5 | L10 | 52,000 | 8 | 0.1 |
| HM-58 | Oct. 5 | 85.0 | - | - | 15 | 11,100 | 235,000 | 60 | 1.5 |
| HM-59 | Oct. 5 | 2.0 | - | - | 5 | L10 | 15,000 | 4 | - |
| HM-61 | Oct. 5 | 1.0 | - | - | 5 | L10 | 10,300 | 0 | - |
| HM-62 | Oct. 5 | 2.0 | - | - | 5 | L10 | 62,000 | 8 | - |
| HM-63 | Oct. 5 | 1.0 | - | - | <5 | 20 | 6,000 | 4 | - |
| HM-66 | Oct. 5 | 9.5 | - | - | 5 | 7,700 | 1,900,000 | 6 | 0.3 |
| HM-68 | Oct. 5 | 300.0 | - | - | 15 | 10 | 800 | 15 | 30.0 |
| HM-70 | Oct. 5 | 8.5 | - | - | 10 | 500 | 670,000 | 10 | - |
| HM-71 | Oct. 5 | 6.0 | - | - | 5 | 660 | 134,000 | 6 | 0.2 |
| HM-72 | Oct. 5 | 1.0 | - | - | 5 | 8,000 | 540,000 | 4 | - |
| HM-73 | Oct. 5 | 95.0 | - | - | 280 | 8,000 | 540,000 | 16 | - |
| HM-74 | Oct. 5 | 3.0 | - | - | 5 | 20 | 20,300 | 0 | - |
| HM-76 | Oct. 5 | 3.0 | - | - | 5 | 390 | 10,100 | 4 | - |
| HM-77 | July 20 | 12.0 | 1130 | 1120 | 10 | 1 | 20 | 2 | - |

TABLE I - (Cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) Total | SOLIDS (ppm) Dissolved | SOLIDS (ppm) Suspended | COLIFORMS Fecal | COLIFORMS Total | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| HM-78 | July 20 | 1.0 | 260 | 255 | 5 | 1,000 | 8,700 | 0 | - |
| HM-79 | July 20 | 0.4 | 310 | 305 | 5 | 468 | 4,800 | 0 | - |
| HM-80 | July 20 | 0.6 | 1380 | 1375 | 5 | 1 | 436 | 0 | - |
| HM-81 | July 20 | 0.4 | 320 | 315 | 5 | 1 | 1 | 2 | - |
| HM-82 | July 20 | 1.8 | 8040 | 8035 | 5 | 104 | 472 | 4 | - |
| HM-84 | July 20 | 7.0 | 7240 | 7235 | 5 | 92 | 4,000 | 4 | - |
| HM-85 | July 20 | 8.0 | 7630 | 7625 | 5 | 92 | 3,700 | 4 | - |
| HM-87 | July 20 | 1.0 | 590 | 585 | 5 | 1 | 8 | 6 | - |
| HM-88 | July 20 | 0.4 | 2300 | 2295 | 5 | 20 | 116 | 6 | - |
| HM-91 | July 20 | 0.6 | 680 | 675 | 5 | 476 | 4,500 | 2 | - |
| HM-93 | July 20 | 0.8 | 640 | 635 | 5 | 352 | 2,100 | 4 | - |
| HM-94 | Aug. 8 | 0.6 | 1510 | 1500 | 10 | 48 | 1,600 | - | - |
| HM-95 | July 21 | 3.5 | 310 | 300 | 10 | 16 | 12,600 | - | - |
| HM-96 | July 21 | 3.0 | 520 | 505 | 15 | - | - | - | - |
| HM-97 | July 21 | 1.6 | 450 | 440 | 10 | 180 | 3,000 | - | - |

TABLE I - (Cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENT ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| HM-98 | July 21 | 5.0 | 520 | 515 | 5 | 8 | 304 | - | - |
| HM-99 | July 21 | 1.2 | 610 | 605 | 5 | 100 | 370 | - | - |
| HM-100 | July 21 | 12.0 | 890 | 760 | 130 | 1,300 | G15,000 | - | - |
| HM-102 | July 21 | 1.0 | 1300 | 1295 | 5 | G15,000 | G15,000 | - | - |
| HM-103 | July 21 | 1.0 | 1350 | 1345 | 5 | 80 | 6 200 | 4 | - |
| HM-104 | July 21 | 3.0 | 500 | 465 | 35 | 730 | 8,900 | 6 | - |
| HM-105 | July 21 | 0.6 | 1030 | 1025 | 5 | L10 | 270 | 12 | - |
| HM-106 | July 21 | 1000.0 | 2850 | 2690 | 160 | 300 | 4,500 | 550 | - |
| | Aug 8 | 600.0 | 2420 | 2330 | 90 | 900 | 100,000 | 700 | - |
| HM-107 | July 21 | 1.4 | 1060 | 900 | 160 | 340 | 4,500 | 8 | - |
| HM-108 | July 21 | 3.5 | 1170 | 1020 | 150 | 670 | G15,000 | 8 | - |
| HM-109 | July 21 | 11.0 | 1420 | 1270 | 150 | 5,000 | G15,000 | 4 | - |
| HM-111 | July 21 | 6.0 | 1200 | 1185 | 15 | 12 | 3,300 | 4 | - |
| HM-112 | July 20 | 2.0 | 320 | 305 | 15 | 80 | 1 | 4 | - |
| HM-113 | July 20 | 2.0 | 640 | 550 | 90 | 236 | 9,200 | 4 | - |

TABLE I - (Cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENT ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| HM-114 | July 20 | 65.0 | 1430 | 1425 | 5 | 28 | 4,700 | 8 | - |
| HM-115 | July 20 | 1.4 | 950 | 940 | 10 | 64 | 5,200 | 2 | - |
| HM-116 | July 20 | 3.0 | 360 | 355 | 5 | 176 | 340 | 2 | - |
| HM-117 | July 20 | 0.4 | 1480 | 1470 | 10 | 196 | 10,300 | 6 | - |
| HM-119 | July 20 | 28.0 | 1110 | 1085 | 25 | 800 | 44,000 | 4 | - |
| HM-120 | July 20 | 3.5 | 1760 | 1750 | 10 | 60 | 390,000 | 2 | 1.4 |

TABLE II

ANALYTICAL RESULTS - HUMBER RIVER - WEST BRANCH

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (PPM) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| HW-5 | Oct. 6 | 11.0 | 580 | 565 | 15 | 5,900 | 190,000 | 6 | - |
| HW-11 | Oct. 6 | 8.0 | 740 | 730 | 10 | 5,300 | 950,000 | 8 | - |
| HW-14 | Oct. 6 | 40.0 | 540 | 500 | 40 | 400 | 319,000 | 15 | - |
| HW-15 | Oct. 6 | 60.0 | 770 | 700 | 70 | 103,000 | 63,000,000 | 15 | - |
| HW-16 | Oct. 6 | 65.0 | 640 | 620 | 20 | 89,000 | 460,000 | 10 | 1.3 |
| HW-20 | Oct. 5 | 13.0 | 650 | 540 | 110 | 3,000 | 530,000 | 4 | - |
| HW-27 | Oct. 5 | 5.5 | 240 | 235 | 5 | 30 | 3,000 | 10 | - |
| HW-28 | Oct. 5 | 5.5 | 240 | 235 | 5 | 10 | 1,700 | 6 | - |

TABLE III

ANALYTICAL RESULTS - BLACK CREEK

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| BC-3 | Oct. 5 | 36.0 | 970 | 945 | 25 | 7,000 | 7,200,000 | 10 | - |
| BC-6 | Oct. 5 | 2.0 | 690 | 685 | 5 | 30 | 223,000 | 2 | - |
| BC-9 | Oct. 5 | 9.5 | 750 | 740 | 10 | L100 | 69,000,000 | 4 | - |
| BC-11 | Oct. 5 | 1.2 | 560 | 555 | 5 | 30 | 3,000 | 6 | - |
| BC-19 | Oct. 5 | 9.0 | 380 | 365 | 15 | G15,000 | G15,000 | 6 | 0.1 |
| BC-21 | Oct. 5 | 9.0 | 390 | 365 | 25 | G15,000 | G15,000 | 15 | - |
| BC-23 | Oct. 5 | 1.0 | 810 | 805 | 5 | L10 | L10 | 0 | - |
| BC-27 | Oct. 5 | 1.4 | 220 | 215 | 5 | L10 | 10 | 2 | - |
| BC-28 | Oct. 5 | 1.2 | 680 | 675 | 5 | 60 | 16,400 | 2 | - |
| BC-29 | Oct. 5 | 2.5 | 1190 | 1185 | 5 | 140 | 2,500 | 4 | - |
| BC-31 | Oct. 5 | 8.5 | 3340 | 3315 | 25 | 2,900 | 15,000 | 2 | - |
| BC-32 | Oct. 5 | 18.0 | 990 | 985 | 5 | 238,000 | 95,000,000 | 4 | - |
| BC-41 | Oct. 6 | 1.2 | 230 | 220 | 10 | 20 | 148,000 | 4 | - |
| BC-42 | Oct. 5 | 14.0 | 1560 | 1545 | 15 | L10 | 1,400 | 20 | 0.3 |
| | | | | | | | | | Iron as Fe |
| | | | | | | | | | 12.0 |

TABLE III - (Cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| BC-44 | Oct. 6 | 0.8 | 1320 | 1305 | 15 | L10 | 820 | 2 | - |
| BC-45 | Oct. 6 | 22.0 | 2860 | 2780 | 80 | 760,000 | 79,000,000 | 4 | 6.0 |
| BC-47 | Oct. 6 | 2.0 | 1190 | 1105 | 85 | L10 | 1,700 | 2 | - |
| BC-48 | Oct. 6 | 2.0 | 470 | 460 | 10 | 5,000 | 210,000 | 2 | - |
| BC-51 | Oct. 6 | 26.0 | 530 | 505 | 25 | L10 | 10 | 4 | - |
| BC-54 | Oct. 6 | 9.0 | 350 | 290 | 60 | 400 | 84,000 | 6 | - |
| BC-63 | Oct. 7 | 5.5 | 1400 | 1350 | 50 | 30 | 580 | 2 | - |
| BC-64 | Oct. 7 | 55.0 | 1330 | 1230 | 100 | 110,000 | 2,700,000 | 6 | - |
| BC-65 | Oct. 7 | 8.0 | 1180 | 1165 | 15 | 440 | 17,000 | 8 | - |
| BC-70 | Oct. 7 | 1.6 | 800 | 795 | 5 | G15,000 | G15,000 | 2 | - |
| BC-71 | Oct. 7 | 6.0 | 820 | 800 | 20 | 530 | 1,550 | 4 | - |
| BC-73 | Oct. 7 | 8.0 | 830 | 825 | 5 | 70 | 6,000 | 4 | - |
| BC-75 | Oct. 7 | 2.5 | 530 | 525 | 5 | L10 | 8,900 | 4 | - |
| BC-76 | Oct. 7 | 5.5 | 870 | 810 | 60 | 730 | 13,800 | 8 | - |
| BC-79 | Oct. 7 | 15.0 | 1340 | 1330 | 10 | G15,000 | G15,000 | 4 | - |
| BC-82 | Oct. 7 | 14.0 | 370 | 365 | 5 | 4,300 | G15,000 | 15 | - |
| BC-87 | Oct. 7 | 20.0 | - | - | 5 | 3,900 | G15,000 | 4 | - |

TABLE III - (cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| BC-102 | Oct. 7 | 28.0 | - | - | 280 | 200 | 50,000 | 8 | 1.8 |
| BC-104 | Oct. 7 | 3.0 | - | - | 5 | 460 | 7,100 | 4 | - |
| BC-108 | Oct. 7 | 8.0 | - | - | 30 | 80 | 1,040 | 2 | - |
| BC-126 | Oct. 7 | 6.0 | - | - | 5 | 560 | G15,000 | 4 | - |
| BC-129 | Oct. 7 | 7.0 | - | - | 40 | L10 | 200 | 2 | - |
| BC-135 | Oct. 7 | 3.0 | - | - | 5 | 190 | 4,100 | 2 | - |
| BC-150 | Oct. 6 | 2.5 | - | - | - | L10 | 60 | 6 | - |
| BC-154 | Oct. 6 | 5.5 | - | - | 15 | 1,300 | 106,000 | 4 | - |
| BC-159 | Oct. 6 | 44.0 | - | - | 570 | 390,000 | 23,500,000 | 0 | - |
| BC-160 | Oct. 6 | 1.2 | - | - | 10 | L10 | 9,000 | 0 | - |
| BC-162 | Oct. 6 | 26.0 | - | - | 45 | 6,100 | 6,800,000 | 0 | - |
| BC-163 | Oct. 6 | 9.5 | - | - | 35 | 900 | 255,000 | 0 | - |
| BC-165 | Oct. 5 | 1.6 | - | - | 15 | 6,100 | 130,000 | 2 | - |
| BC-166 | Oct. 5 | 12.0 | - | - | 10 | 3,900 | 1,290,000 | 6 | - |
| BC-167 | Oct. 5 | 30.0 | - | - | 225 | 12,600 | 121,000 | 15 | - |

TABLE III - (cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) Total | Dissolved | Suspended | COLIFORMS Fecal | Total | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| BC-168 | Oct. 5 | 7.0 | - | - | 5 | L10 | 1,180 | 6 | - |
| BC-170 | Oct. 5 | 2.0 | - | - | 25 | 4,300 | 40,000 | 2 | - |
| BC-175 | Oct. 5 | 2.0 | - | - | 5 | 10 | 990 | 2 | - |
| BC-178 | Oct. 5 | 6.5 | - | - | 25 | 590 | 250,000 | 2 | - |

TABLE IV

ANALYTICAL RESULTS - SAMPLE POINTS ON HUMBER RIVER - MAIN AND WEST BRANCHES AND BLACK CREEK

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| A | Oct. 13 | 1.8 | 450 | 410 | 40 | 1,700 | 24,000 | 10 | - |
| B | Oct. 13 | 2.0 | 460 | 430 | 30 | 1,800 | 40,000 | 8 | - |
| C | Oct. 13 | 1.6 | 650 | 635 | 15 | 470 | 29,000 | 15 | - |
| D | Oct. 13 | 2.0 | 450 | 440 | 10 | 5,100 | 37,000 | 6 | - |
| E | Oct. 13 | 14.0 | 1470 | 1170 | 300 | 300 | 35,000 | 20 | - |
| F | Oct. 13 | 1.4 | 430 | 420 | 10 | 6,300 | 27,700 | 8 | - |
| G | Oct. 7 | 2.5 | - | - | 25 | 330 | 9,200 | 2 | - |
| H | July 20 | 1.2 | 350 | 335 | 15 | 164 | 1,700 | 0 | - |
| | Oct.5 | 4.0 | - | - | 30 | 100 | 8,400 | 6 | - |
| I | July 20 | 1.8 | 350 | 340 | 10 | 244 | 2,100 | 2 | - |
| J | July 21 | 1.0 | 320 | 305 | 15 | 7,000 | 12,600 | - | - |
| K | July 20 | 2.5 | 320 | 305 | 15 | 80 | 140 | 4 | - |
| L | July 20 | 2.5 | 290 | 255 | 35 | 180 | 700 | 8 | - |
| M | Oct. 6 | 2.0 | 500 | 490 | 10 | 20 | 2,800 | 4 | - |

TABLE IV - (Cont'd)

| SAMPLE POINT | DATE SAMPLED (1971) | 5-DAY BOD (ppm) | SOLIDS (ppm) | | | COLIFORMS | | PHENOLS (ppb) | ANIONIC DETERGENTS ABS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Dissolved | Suspended | Fecal | Total | | |
| N | Oct. 6 | 3.0 | 480 | 465 | 15 | 80 | 3,900 | 6 | - |
| O | Oct. 6 | 5.5 | 800 | 795 | 5 | 1,700 | 46,000 | 10 | - |
| P | Oct. 6 | 24.0 | 660 | 630 | 30 | 12,900 | 2,340,000 | 6 | - |
| Q | Oct. 6 | 2.5 | 590 | 575 | 15 | 1,270 | 20,000 | 8 | - |
| R | Oct. 6 | 4.0 | 370 | 340 | 30 | 440 | 1,060 | 2 | - |
| S | Oct. 5 | 4.0 | 760 | 755 | 5 | - | - | 6 | - |
| T | Oct. 6 | 3.0 | - | - | 20 | 500 | 29,000 | 2 | Chloride as Cl .210 ppm |
| U | Oct. 5 | 3.0 | - | - | 5 | 140 | 620 | 4 | - |
| | Aug. 30 | 2.5 | 750 | 730 | 20 | 2,700 | 60,000 | 2 | - |

# TABLE V

## WATER QUALITY DATA - HUMBER RIVER AT LAKESHORE BOULEVARD

| YEAR (No. of Samples) | 5-DAY BOD (ppm) | | | SUSPENDED SOLIDS (ppm) | | | COLIFORM BACTERIA PER 100 ML | | |
|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Geometric Mean |
| 1971 (5) | 7.0 | 2.5 | 4.0 | 230 | 10 | 78 | 43,000 | 410 | 1,100 |
| 1970 (18) | 8.5 | 2.0 | 4.1 | 445 | 5 | 72 | 250,000 | 100 | 4,500 |
| 1969 (8) | 4.5 | 1.6 | 3.2 | 190 | 10 | 52 | 70,000 | 0 | 22,000 |
| 1968 (30) | 6.4 | 0.4 | 2.9 | 715 | 6 | 65 | 60,000 | 272 | 11,000 |
| 1967 (6) | 3.7 | 1.4 | 2.4 | 146 | 15 | 46 | 105,000 | 4,100 | 24,100 |
| 1966 (9) | 6.8 | 2.0 | 4.2 | 350 | 27 | 96 | 150,000 | 812 | 11,300 |
| 1965 (7) | 4.8 | 2.2 | 3.0 | 210 | 33 | 82 | 8,200 | 6 | 4,960 |

TABLE VI

HUMBER RIVER - CLAIRVILLE DAM RESERVOIR

| YEAR (No. of Samples) | 5-DAY BOD (ppm) | | | SUSPENDED SOLIDS (ppm) | | | COLIFORM BACTERIA PER 100 ML | | |
|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Geometric Mean |
| 1971 (4) | 2.0 | 0.6 | 1.6 | 320 | 10 | 90 | 157,000 | 80 | 1,183 |
| 1970 (10) | 4.5 | 0.8 | 2.1 | 40 | 5 | 20 | 3,800 | 4 | 836 |
| 1969 (4) | 2.0 | 0.8 | 1.4 | 35 | 30 | 23 | 220 | 220 | 220 |
| 1968 | 8.2 | 1.0 | 2.8 | 722 | 8 | 25 | 28,000 | 0 | 325 |
| 1967 | 2.9 | 2.4 | 2.6 | 45 | 11 | 32 | 870 | 12 | 331 |
| 1966 (8) | 3.4 | 1.3 | 2.2 | 40 | 3.6 | 33 | 116,000 | 330 | 15,500 |
| 1965 (8) | 3.8 | 1.5 | 2.5 | 28 | 11 | 19 | 81,000 | 350 | 9,725 |

## APPENDIX I

## POINTS OF DISCHARGE TO HUMBER RIVER - MAIN BRANCH

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-1 | 24" C.M.P. (Corrugated Metal Pipe) Etobicoke side under Gardiner Expressway bridge | | x |
| HM-2 | 38" Concrete outfall, Toronto side, north of CNR bridge | x | |
| HM-3 | 42" Concrete outfall, Toronto side, just north of HM-2 | x | |
| HM-4 | 8" Concrete outfall, Etobicoke side, north of CNR bridge | | x |
| HM-5 | 6" Cast iron pipe, Etobicoke side | | x |
| HM-6 | 42" Concrete outfall, just north of Queensway, Etobicoke side | x | |
| HM-7 | 60" Concrete outfall, west side | x | |
| HM-8 | 12" C.M.P., broken on side at hill, east side | | x |
| HM-9 | 42" Concrete outfall, east side | x | |
| HM-10 | 42" Concrete outfall, Toronto side | x | |
| HM-11 | 8" C.M.P., Toronto side | | x |
| HM-12 | 12" C.M.P., Etobicoke side | | x |
| HM-13 | 24" C.M.P., Etobicoke side | x | |
| HM-14 | 7' x 9' Concrete outfall approx. 100' back from river on Etobicoke side | x | |
| HM-15 | Leachate at Old Mill Dumpsite Etobicoke side | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-16 | 24" C.M.P., Etobicoke side | x | |
| HM-17 | 9' Concrete storm sewer outfall, Etobicoke side | | x |
| HM-18 | Seasonal drainage course, Etobicoke side | | x |
| HM-19 | 18" x 16" rectangular storm sewer, under Bloor bridge, York side | | x |
| HM-20 | 32" Concrete outfall, Etobicoke side | x | |
| HM-21 | 30" C.M.P., just upstream from Old Mill Road bridge, on York Side | x | |
| HM-22 | 48" C.M.P., just upstream from 30" C.M.P., York side | x | |
| HM-23 | 24" C.M.P., insufficient flow, York side | | x |
| HM-24 | 18" x 24" Concrete outfall, no flow, Etobicoke side | | x |
| HM-25 | 56" C.M.P., Etobicoke side | x | |
| HM-26 | 16" C.M.P., Etobicoke side | | x |
| HM-27 | 8" C.M.P., Etobicoke side | | x |
| HM-28 | 24" C.M.P., Etobicoke side | x | |
| HM-29 | 16" C.M.P., Etobicoke side | | x |
| HM-30 | 4" Clay tile, Etobicoke side | | x |
| HM-31 | 48" square concrete storm sewer, York side | x | |
| HM-32 | 12" C.I.P (cast iron pipe), Etobicoke side, south of water fall | | x |
| HM-33 | 24" concrete outfall, York side | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-34 | 30" C.M.P., Etobicoke side | | x |
| HM-35 | 36" Concrete outfall, approx. 200' downstream from Dundas Street | x | |
| HM-36 | 12" C.M.P., in the side of a cliff behind lumber yard, Etobicoke side | | x |
| HM-37 | 48" Concrete outfall just upstream from the C.P.R. bridge, Etobicoke side | x | |
| HM-38 | Seasonal drainage course, York side | | x |
| HM-39 | 24" C.M.P. with concrete abutment, York side | | x |
| HM-40 | Small stream across the Humber from mouth of Black Creek, Etobicoke side | x | |
| HM-41 | Stream across from Lambton Golf Course, Etobicoke side | x | |
| HM-42 | Stream across from Lambton Golf Course, Etobicoke side | x | |
| HM-43 | Drainage course fed by 18" C.M.P. storm sewer from subdivision, Etobicoke side | x | |
| HM-44 | 48" Concrete outfall, just downstream from Scarlett Road bridge, Etobicoke side | x | |
| HM-45 | 18" Concrete outfall and upstream from Scarlett Road bridge, York Side | x | |
| HM-46 | Stream 100' upstream from Scarlett Road bridge, York side | x | |
| HM-47 | 24" C.M.P., with concrete abutment, Etobicoke side | x | |
| HM-48 | 36" Concrete outfall off the end of Richview Side Road, Etobicoke side | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-49 | Creek, Etobicoke side | x | |
| HM-50 | 12" Clay tile in the side of embankment, York side | | x |
| HM-51 | 18" Concrete outfall to small inlet in river, Etobicoke side | x | |
| HM-52 | 36" Concrete outfall, York side | x | |
| HM-53 | 30" Concrete outfall, York side | | x |
| HM-54 | 18" Concrete outfall, York side | | x |
| HM-55 | 24" C.M.P., Etobicoke side | | x |
| HM-56 | 12" C.M.P., Etobicoke side | | x |
| HM-57 | 18" C.M.P., Etobicoke side | | x |
| HM-58 | 8' half circle, Concrete outfall, York side | x | |
| HM-59 | 10" Concrete outfall, York side | x | |
| HM-60 | Drainage course, York side | | x |
| HM-61 | 18" Concrete outfall, York side | x | |
| HM-62 | 6" Concrete tile near sanitary sewer manhole | x | |
| HM-63 | 30" C.M.P., York side, downstream from Lawrence Avenue | x | |
| HM-64 | 8" C.M.P., York side, downstream from Lawrence Avenue | | x |
| HM-65 | 12" C.M.P., just upstream from Lawrence Avenue, York side | | x |
| HM-66 | 24" C.M.P., just downstream from Lawrence Avenue, Etobicoke side | x | |
| HM-67 | 8" Clay tile, just upstream from Lawrence Avenue, Etobicoke side | | x |
| HM-68 | 12" C.M.P., upstream from Lawrence Avenue, Etobicoke side | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-69 | 12" C.M.P., in park north of Lawrence Avenue, York side | | x |
| HM-70 | Concrete outfall, recently cleaned out, covered by wood planks, York side | x | |
| HM-71 | 14" C.M.P., York side, near apartment buildings | x | |
| HM-72 | Concrete storm sewer outfall just downstream from St. Phillips Road bridge, Etobicoke side | x | |
| HM-73 | 12" C.M.P., brownish effluent just upstream from St. Phillips Road bridge, York side | x | |
| HM-74 | 8" pipe from direction of Weston Golf Club discharging to open drainage way then entering river just upstream from St. Phillips Road bridge, Etobicoke side | x | |
| HM-75 | Seasonal drainage course, Etobicoke side | | x |
| HM-76 | Small stream draining across golf course approx. 300' downstream from CNR bridge, Etobicoke side | x | |
| HM-77 | Storm sewer outfall, North York side | x | |
| HM-78 | Small creek, North York side | x | |
| HM-79 | Small drainage course, Etobicoke side | x | |
| HM-80 | 30" Concrete storm sewer outfall, Etobicoke side | x | |
| HM-81 | Small drainage course, Etobicoke side | x | |
| HM-82 | 60" Concrete storm sewer outfall, Etobicoke side | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-83 | 14" Conctete outfall, Etobicoke side | | x |
| HM-84 | 24" Concrete storm sewer outfall, North York side | x | |
| HM-85 | 24" Concrete storm sewer outfall, North York side | x | |
| HM-86 | Small drainage course, Etobicoke side | | x |
| HM-87 | 48" Concrete storm sewer outfall, at foot or Blondin Avenue, North York side | x | |
| HM-88 | 30" Concrete outfall, Etobicoke side | x | |
| HM-89 | 14" Concrete outfall, Etobicoke side | | x |
| HM-90 | 12" Concrete outfall, Etobicoke side | | x |
| HM-91 | 36" Concrete outfall, Etobicoke side | x | |
| HM-92 | Drainage course, Etobicoke side | | x |
| HM-93 | Creek entering Humber at Albion Road, Etobicoke side | x | |
| HM-94 | 24" Concrete outfall at end of Flindon Road, North York side | x | |
| HM-95 | 60" Concrete outfall, North York side | x | |
| HM-96 | Small drainage course, dry, North York side | x | |
| HM-97 | 36" Storm sewer outfall Etobicoke side | x | |
| HM-98 | Pond located between Humber River and Florida Crescent, North York side | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-99 | Small creek, Etobicoke side | x | |
| HM-100 | 24" Concrete outfall, North York side | x | |
| HM-101 | 18" C.M.P., Etobicoke side | | x |
| HM-102 | 48" concrete outfall, Etobicoke side | x | |
| HM-103 | 42" C.M.P., North York side | x | |
| HM-104 | Stream, North York side | x | |
| HM-105 | 36" Concrete outfall at end of Attwood Place, Etobicoke side | x | |
| HM-106 | Gully opening onto Humber River, orange liquid draining to river, North York side | x | |
| HM-107 | Creek, North York side | x | |
| HM-108 | Creek, North York side | x | |
| HM-109 | 36" Concrete outfall, North York side | x | |
| HM-110 | 42" Concrete outfall, Etobicoke side | | x |
| HM-111 | 48" Concrete outfall, North York side | x | |
| HM-112 | Hole in side of river tank, Etobicoke side | x | |
| HM-113 | Creek, Etobicoke side | x | |
| HM-114 | 36" C.M.P., North York side | x | |
| HM-115 | 18" x 36" oval C.M.P., North York side | x | |
| HM-116 | Creek, Etobicoke side | x | |
| HM-117 | 18" C.M.P., North York side | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HM-118 | 36" Square concrete storm sewer, North York side | | x |
| HM-119 | Creek, Etobicoke side | x | |
| HM-120 | 36" Concrete outfall, North York side | x | |

## APPENDIX II

### POINTS OF DISCHARGE TO HUMBER RIVER - WEST BRANCH

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HW-1 | 54" Concrete outfall, 30 feet back from river, south side | | x |
| HW-2 | 18" C.M.P., north side | | x |
| HW-3 | 6" C.I.P. (cast iron pipe), north side of river | | x |
| HW-4 | 48" Concrete outfall, east of Islington Avenue, north side | | x |
| HW-5 | 42" Concrete outfall, east of Islington Avenue, south side | x | |
| HW-6 | 12" C.I.P., centre of bridge abutment, north side | | x |
| HW-7 | 12" Concrete outfall, south-east corner of bridge abutment | | x |
| HW-8 | 24" Concrete outfall, south side of river | | x |
| HW-9 | 26" Concrete outfall, south side | | x |
| HW-10 | 15" Concrete outfall, on east side of small tributary | | x |
| HW-11 | 18' C.M.P., source of flow to small tributary | x | |
| HW-12 | 60" Concrete outfall, west side of tributary | | x |
| HW-13 | 24" Concrete outfall, elevated 10' above tributary | | x |
| HW-14 | 66" Concrete outfall, approx. 100' back from river on north side | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HW-15 | 48" Concrete outfall, south side | x | |
| HW-16 | 20" Concrete outfall, south side, west of Kipling Avenue | x | |
| HW-17 | 21" Concrete outfall, north-east bridge abutment of Martingrove Road | | x |
| HW-18 | 12" C.I.P., encased in concrete, south-east bridge abutment | | x |
| HW-19 | 9' - 6" x 6' C.M.P., approx. 150' back from river, west of Martingrove Road, north side of river | | x |
| HW-20 | 30" Concrete outfall, west of Martingrove Road | x | |
| HW-21 | 24" Concrete outfall, north side of Highway 27 | | x |
| HW-22 | 10" C.M.P., discharges runoff from parking lot, north side just east of Highway 27 | | x |
| HW-23 | 14" C.M.P., north-east bridge abutment under Highway 27 | | x |
| HW-24 | 12" C.M.P., south-west bridge abutment under Highway 27 | | x |
| HW-25 | 25" C.M.P., north-west bridge abutment under Highway 27 | | x |
| HW-26 | 42" Concrete outfall, located back from river west of Highway 27 | | x |
| HW-27 | 36" C.M.P., approx. 1,000' back from river on south side | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| HW-28 | 36" C.M.P., same location as HW-27 | x | |
| HW-29 | 2" C.I.P., north side of river just east of Indian Line | | x |

All outfalls discharging to the West Branch of the Humber River are located in the Borough of Etobicoke.

## APPENDIX III

## POINTS OF DISCHARGE TO BLACK CREEK

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-1 | 18" C.M.P., south side of creek west of Scarlett Road, Borough of York | | x |
| BC-2 | 15" C.M.P., north side of creek, west of Scarlett Road, Borough of York | | x |
| BC-3 | 27" C.M.P., north side of creek, east of Scarlett Road, Borough of York | x | |
| BC-4 | 27" Concrete pipe, north side of creek, Borough of York | | x |
| BC-5 | 6" Clay tile, south side of creek, Borough of York | | x |
| BC-6 | 12" Concrete outfall, south side of creek, Borough of York | x | |
| BC-7 | 18" Concrete outfall, north side of creek, Borough of York | | x |
| BC-8 | 12" C.M.P., south side of creek, Borough of York | | x |
| BC-9 | 24" Concrete outfall, south side of creek, Borough of York | x | |
| BC-10 | 12" Concrete outfall, south side of creek, Borough of York | | x |
| BC-11 | 12" C.M.P., south side of creek, Borough of York | x | |
| BC-12 | 12" Concrete outfall, north side of creek, Borough of York | | x |
| BC-13 | 12" Concrete outfall, south side of creek, Borough of York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-14 | 9" Clay tile, south side of creek, Borough of York | | x |
| BC-15 | 6" Clay tile, north side of creek, Borough of York | | x |
| BC-16 | 8" Clay tile, south side of creek, Borough of York | | x |
| BC-17 | 12" C.M.P., south side of creek, west of Jane Street, Borough of York | | x |
| BC-18 | 15" Concrete outfall, north side of creek, west of Jane Street, Borough of York | | x |
| BC-19 | 24" Concrete outfall, south side of creek, under Jane Street bridge, Borough of York | x | |
| BC-20 | 12" Concrete outfall, north side of creek, east of Jane Street, Borough of York | | x |
| BC-21 | 18" Concrete outfall, north side of creek, east of Jane Street, Borough of York | x | |
| BC-22 | 21" Concrete outfall, north side of creek, Borough of York | | x |
| BC-23 | 18" Transite pipe, south side of creek, Borough of York | x | |
| BC-24 | 42" Concrete outfall, north side of creek, west of Rockcliffe Blvd., Borough of York | | x |
| BC-25 | 14' x 5' Concrete box outfall, south side of creek, west of Rockcliffe Blvd., Borough of York | | x |
| BC-26 | 36" Concrete outfall and bridge at Rockcliffe Blvd., Borough of York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-27 | 12" C.M.P. outfall, north side of creek, east of Rockcliffe Blvd., Borough of York | x | |
| BC-28 | 15" C.M.P. outfall, north side of creek, Borough of York | x | |
| BC-29 | 14' x 5' Concrete box outfall, south side of creek, Borough of York | x | |
| BC-30 | 14" Transite pipe, north side of creek, Borough of York | | x |
| BC-31 | Small tributary, Borough of York, south side of creek | x | |
| BC-32 | 4' x 5' Concrete box culvert, north side of creek, Borough of York | x | |
| BC-33 | 21" Concrete outfall, south side of creek, opposite end of Alliance Avenue, Borough of York | | x |
| BC-34 | 8" Concrete outfall, located directly above BC33, south side of creek, Borough of York | | x |
| BC-35 | 4" Clay tile, south side of creek, Borough of York | | x |
| BC-36 | 12" Concrete outfall, located above BC-35, Borough of York | | x |
| BC-37 | 12" Concrete outfall, south side of creek, Borough of York | | x |
| BC-38 | 12" Concrete outfall, north side of Creek, Borough of York | | x |
| BC-39 | 27" Concrete outfall, south side of creek, Borough of York | | x |
| BC-40 | 8" Concrete outfall, north side of creek, Borough of York | | x |
| BC-41 | 21" Concrete outfall, north side of creek, Borough of York | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-42 | 36" Concrete outfall, south side of creek, Borough of York | x | |
| BC-43 | 12" Concrete outfall, north side of creek, Borough of York | | x |
| BC-44 | 36" Concrete outfall, south side of creek, Borough of York | x | |
| BC-45 | 12" Concrete outfall, south side of creek, west of Weston Road, Borough of York | x | |

NOTE: Black Creek is now flowing north to south and outfalls previously described as being located on the south side of the creek are now considered as being on the east side and likewise for the outfall previously on the north side.

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-46 | 12' x 5' Concrete box outfall, just upstream from the CPR bridge and on the east side of the creek, Borough of York, **relief sewer** | | x |
| BC-47 | 8" Concrete outfall from construction site, east side of creek, Borough of York | x | |
| BC-48 | 21" Concrete outfall, east side of creek, south of Eglinton Avenue, Borough of York | x | |
| BC-49 | 12" C.M.P., outfall, west side Borough of York, south of Eglinton | | x |
| BC-50 | 60" Concrete pipe, south of Eglinton, east side, Borough of York | | x |
| BC-51 | 72" Concrete outfall, south of Eglinton, west side, Borough of York | x | |
| BC-52 | Seasonal watercourse, just north of Eglinton Avenue, west side, Borough of York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-53 | 36" Concrete outfall, west side, Borough of York | | x |
| BC-54 | 48" Concrete outfall, west side, Borough of York | x | |
| BC-55 | Seasonal watercourse, west side, Borough of York | | x |
| BC-56 | Ditch fed by 15" C.M.P., west side at Trethewey Drive , Borough of York | | x |
| BC-57 | 27" Concrete outfall, east side at Trethewey Drive, Borough of York | | x |
| BC-58 | 27" Concrete outfall, under Trethewey Drive, east side, Borough of York | | x |
| BC-59 | Seasonal drainage course, east side, Borough of York | | x |
| BC-60 | Seasonal drainage course, west side, Borough of North York | | x |
| BC-61 | 27" Concrete outfall and flow way, east side, Borough of North York | | x |
| BC-62 | Watercourse fed by 12" concrete pipe, east side, Borough of North York | | x |
| BC-63 | Watercourse, west side, Borough of North York | x | |
| BC-64 | 4" metal pipe, west side, Borough of North York | x | |
| BC-65 | Watercourse from 10' C.M.P., east side, Borough of North York | x | |
| BC-66 | 27" Concrete pipe and ditch, west side, Borough of North York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-67 | 24" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-68 | 21" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-69 | 3 seasonal drainage courses, east side, Borough of North York | | x |
| BC-70 | 24" Concrete pipe outfall, west side, Borough of North York | x | |
| BC-71 | 66" C.M.P., east side, Borough of North York | x | |
| BC-72 | 15" C.M.P., west side, south of Lawrence, Borough of North York | | x |
| BC-73 | Watercourse from culvert under Lawrence, Borough of North York | x | |
| BC-74 | 36" Concrete pipe outfall under Lawrence, Borough of North York | | x |
| BC-75 | 27" Concrete pipe outfall, west side under Lawrence, Borough of North York | x | |
| BC-76 | Watercourse, east side, Borough of North York | x | |
| BC-77 | Drainage course fed by C.M.P., east side, Borough of North York | | x |
| BC-78 | 24" C.M.P., west side, Borough of North York | | x |
| BC-79 | 21" Concrete pipe outfall and flow way, west side, Borough of North York | x | |
| BC-80 | 2 - 12" Concrete pipe outfalls, west side, Borough of North York | | x |
| BC-81 | 21" Concrete pipe outfall, west side, Borough of North York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-82 | Watercourse, west side, Borough of North York | x | |
| BC-83 | 12" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-84 | 6" C.M.P., at Maple Leaf Drive, west side, Borough of North York | | x |
| BC-85 | 6" C.M.P., and 10" C.M.P., east side at Maple Leaf Drive, Borough of North York | | x |
| BC-86 | 72" Concrete pipe outfall, just north of Maple Leaf Drive, Borough of North York | | x |
| BC-87 | Watercourse, east side, Borough of North York | x | |
| BC-88 | 15" Concrete pipe outfall, west side, North York | | x |
| BC-89 | 18" C.M.P., outfall, west side, Borough of North York | | x |
| BC-90 | 60" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-91 | 12" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-92 | 21" Concrete pipe outfall, west side just downstream from Jane Street, Borough of North York | | x |
| BC-93 | 24" Concrete pipe outfall, east side, just downstream from Jane Street, Borough of North York | | x |
| BC-94 | 54" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-95 | 18" C.M.P., outfall, east side, Borough of North York | | x |
| BC-96 | 30" Concrete pipe outfall, west side, Borough of North York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-97 | 10" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-98 | 21" Concrete pipe outfall, west side, south of Mackay Road, Borough of North York | | x |
| BC-99 | 30" Concrete pipe outfall, east side, south of Mackay Road, Borough of North York | | x |
| BC-100 | Watercourse fed by 66" C.M.P. west side, approx. 200' north of Mackay Road, Borough of North York | | x |
| BC-101 | 36" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-102 | 21" Concrete pipe outfall, east side, west of Jane Street, Borough of North York | x | |
| BC-103 | 18" C.M.P., outfall, east side, east of Jane Street, Borough of North York | | x |
| BC-104 | 66" Concrete pipe outfall, east side under Hwy 401, Borough of North York | x | |
| BC-105 | 24" C.M.P., outfall,west side, under Hwy 401, Borough of North York | | x |
| BC-106 | 24" Concrete pipe outfall, above centre of creek, under Hwy 401, Borough of North York | | x |
| BC-107 | 24" C.M.P., west side, under Hwy 401, Borough of North York | | x |
| BC-108 | 6' x 12' Concrete box outfall, east side, just north of Hwy 401, Borough of North York | x | |
| BC-109 | 30" Concrete pipe outfall, east side, just south of Downsview Avenue, Borough of North York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-110 | 12" C.M.P., outfall, west side, just south of Downsview Avenue, Borough of North York | | x |
| BC-111 | 15" C.M.P., outfall, west side, just north of Downsview Avenue, Borough of North York | | x |
| BC-112 | 12" C.M.P. outfall, east side, just north of Downsview Avenue, Borough of North York | | x |
| BC-113 | 48" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-114 | 30" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-115 | 18" C.M.P. outfall, west side, Borough of North York | | x |
| BC-116 | 9" Concrete outfall, west side, Borough of North York | | x |
| BC-117 | 8" C.M.P., outfall, east side, south of Wilson Avenue, Borough of North York | | x |
| BC-118 | 48" Concrete outfall, east side, south of Wilson Avenue, Borough of North York | | x |
| BC-119 | 12" Concrete outfall, east side, north of Wilson Avenue, Borough of North York | | x |
| BC-120 | 48" C.M.P., outfall, east side just north of Wilson Avenue, Borough of North York | | x |
| BC-121 | 24" Concrete pipe outfall, east side, approx. 200' north of Wilson Avenue, Borough of North York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-122 | 60" Concrete pipe outfall, east side of Jane Street Borough of North York | | x |
| BC-123 | 18" C.M.P. outfall, west side of Jane Street, Borough of North York | | x |
| BC-124 | 18" C.M.P., outfall, west side at Jane Street, Borough of North York | | x |
| BC-125 | 12" C.M.P. outfall, east side, at Jane Street, Borough of North York | | x |
| BC-126 | 72" Concrete pipe outfall, west side, just upstream from Jane Street, Borough of North York | x | |
| BC-127 | 8" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-128 | 8" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-129 | 18" Concrete pipe outfall, west side, Borough of North York | x | |
| BC-130 | 8" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-131 | 8" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-132 | 48" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-133 | 10" Concrete pipe outfall,west side, Borough of North York | | x |
| BC-134 | 15" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-135 | Watercourse fed by 48" Concrete pipe, west side, Borough of North York | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-136 | 15" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-137 | 10" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-138 | 84" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-139 | 21" C.M.P., Outfall, east side, Borough of North York | | x |
| BC-140 | 42" Concrete pipe outfall, west side, Borough of North York | | x |

NOTE: At this point Black Creek changes from a north-south to an east-west direction. Points of discharge are now described as north side instead of west side and south side instead of east.

| | | | |
|---|---|---|---|
| BC-141 | Watercourse, north side, Borough of North York | | x |
| BC-142 | Watercourse, north side, Borough of North York | | x |
| BC-143 | Pipe, size unknown, under Jane Street, south side, Borough of North York | | x |
| BC-144 | Pipe, size unknown, under Jane Street, north side, Borough of North York | | x |
| BC-145 | Seasonal watercourse, north side, Borough of North York | | x |
| BC-146 | Seasonal watercourse, north side, Borough of North York | | x |
| BC-147 | Seasonal watercourse, south side, Borough of North York | | x |
| BC-148 | Seasonal watercourse, north side, Borough of North York | | x |
| BC-149 | Seasonal watercourse, south side, Borough of North York | | x |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-150 | Springs, north side, Borough of North York | x | |
| BC-151 | 12" C.M.P. outfall, north side, Borough of North York | | x |

NOTE: Black Creek returns to a north-south direction.

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-152 | Seasonal watercourse, east side, Borough of North York | | x |
| BC-153 | Seasonal watercourse, west side, Borough of North York | | x |
| BC-154 | Watercourse, east side, Borough of North York | x | |
| BC-155 | 27" x 54" oval C.M.P., east side, Borough of North York | | x |
| BC-156 | 42" Concrete pipe outfall, east side, south of Sheppard, Borough of North York | | x |
| BC-157 | 30" Concrete pipe outfall, east side, just south of Sheppard, Borough of North York | | x |
| BC-158 | 4" Plastic pipe, west side, Borough of North York | | x |
| BC-159 | 66" Concrete pipe outfall, east side, Borough of North York | x | |
| BC-160 | 6" Clay tile outfall, west side, Borough of North York | x | |
| BC-161 | 8" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-162 | 27" Concrete pipe outfall, west side, Borough of North York | x | |
| BC-163 | Watercourse, east side, Borough of North York | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-164 | 24" C.M.P. outfall, east side , Borough of North York | | x |
| BC-165 | 72" Concrete pipe outfall, west side, Borough of North York | x | |
| BC-166 | 54" Concrete pipe outfall, east side, Borough of North York | x | |
| BC-167 | 24" C.M.P. outfall, west side, Borough of North York | x | |
| BC-168 | Watercourse, west side, Borough of North York | x | |
| BC-169 | Outfall, under Finch Avenue, size unknown, west side, Borough of North York | | x |
| BC-170 | Outfall, under Finch Avenue, size unknown, east side, Borough of North York | | x |
| BC-171 | 54" Concrete pipe outfall, east side, Borough of North York | x | |
| BC-172 | 30" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-173 | 60" Concrete pipe outfall, east side, Borough of North York | | x |
| BC-174 | 48" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-175 | Watercourse, east side, Borough of North York | x | |
| BC-176 | 27" x 40" C.M.P., east side, Borough of North York | | x |
| BC-177 | 54" Concrete pipe outfall, west side, Borough of North York | | x |
| BC-178 | 60" Concrete pipe outfall, west side, Borough of North York | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| BC-179 | Concrete pipe outfall, size unknown, west side, Borough of North York | | x |

# APPENDIX IV

## SAMPLE POINTS ON HUMBER RIVER, MAIN AND WEST BRANCHES AND BLACK CREEK

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| A | Humber River at Lakeshore Road | x | |
| B | Humber River off Lackies Marina | x | |
| C | Humber River at mouth of creek | x | |
| D | Humber River at the Toronto Humber Yacht Club Marina | x | |
| E | Humber River at mouth of creek | x | |
| F | Humber River at Bloor Street | x | |
| G | Humber River at Dundas Street | x | |
| H | Humber River at North York - York boundary | x | |
| I | Humber River at Albion Road | x | |
| J | Humber River at Royal Palm Court | x | |
| K | Humber River at Finch & Islington | x | |
| L | Humber River at Steeles Avenue | x | |
| M | West Branch at junction of Main Branch | x | |
| N | West Branch at Islington Avenue | x | |
| O | West Branch at creek | x | |
| P | West Branch at Kipling Avenue | x | |
| Q | West Branch at Hwy 27 | x | |
| R | West Branch below Claireville dam | x | |
| S | Black Creek at Main Branch | x | |

| DESIGNATION | DESCRIPTION | SAMPLED YES | SAMPLED NO |
|---|---|---|---|
| T | Black Creek at Jane Street | x | |
| U | Black Creek at Steeles Avenue | x | |

# APPENDIX V

## METEOROLOGICAL DATA

| DATE (1971) | TEMPERATURE ($^{0}F$) High | Low | PRECIPITATION (inches) Rain |
|---|---|---|---|
| July 20 | 74 | 51 | 0.03 |
| July 21 | 79 | 53 | 0.00 |
| October 5 | 70 | 51 | trace |
| October 6 | 62 | 48 | trace |
| October 7 | 52 | 38 | trace |
| October 13 | 57 | 45 | 0.33 |

## GLOSSARY

Biochemical Oxygen Demand ($BOD_5$) - The quantity of oxygen required during the stabilization of decomposable organic matter and oxidizable inorganic matter by aerobic biological action, measured over a five day period at 20°C in the absence of light. $BOD_5$ is used to indicate relative organic content of raw and treated sewage and surface waters, etc.

CMP - Corrugated metal pipe.

Combined Sewer - A sewer that was intended to carry both sanitary and storm flows. A combined sewer system, therefore, has only one local collector sewer on each street, and this collector receives both storm and sanitary wastes.

Contaminate - Introduce or release into a receiving water potentially pathogenic organisms or toxic substances that render the water hazardous for human consumption or domestic use.

Coliform Bacteria - Coliform bacteria are inhabitants of the intestines of man and animals and are present in human sewage in extremely high numbers. In addition, some species of coliform bacteria can be found in soil and decaying vegetation.

Faecal Coliforms - As implied, are of faecal origin and their presence in significant quantity denotes recent contact with human or animal waste.

Outfall - The outlet or mouth of a river, dam, sewer, etc., where it discharges to a lake, river, stream, etc.

Phenolic Compounds - Phenol are hydroxy derivatives of benzine and its condensed nuclei. They are usually present in surface water as a result of contact with petroleum products.

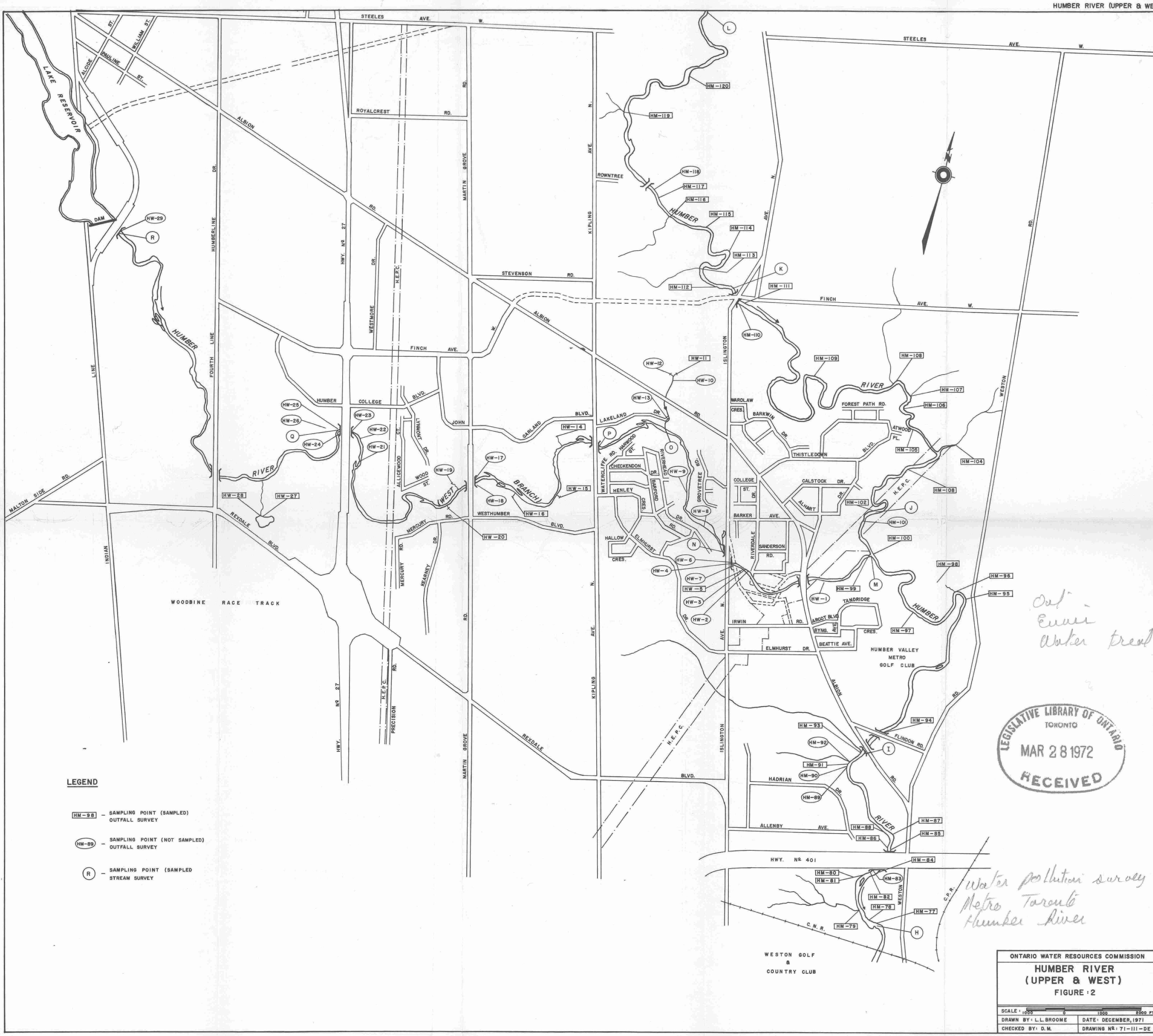
Pollute - Introduce or release into a receiving water substances of such volume and character that the natural quality of the water is altered so as to reduce its usefullness or render it offensive to sight, taste or smell.

Sanitary Sewer - A sewer intended to carry domestic and industrial wastes only.

Separate Sewer System - A sewer system comprising two non-interconnected sets of sewers, one to carry domestic and industrial wastes (sanitary sewer), and one to carry storm water (storm sewer).

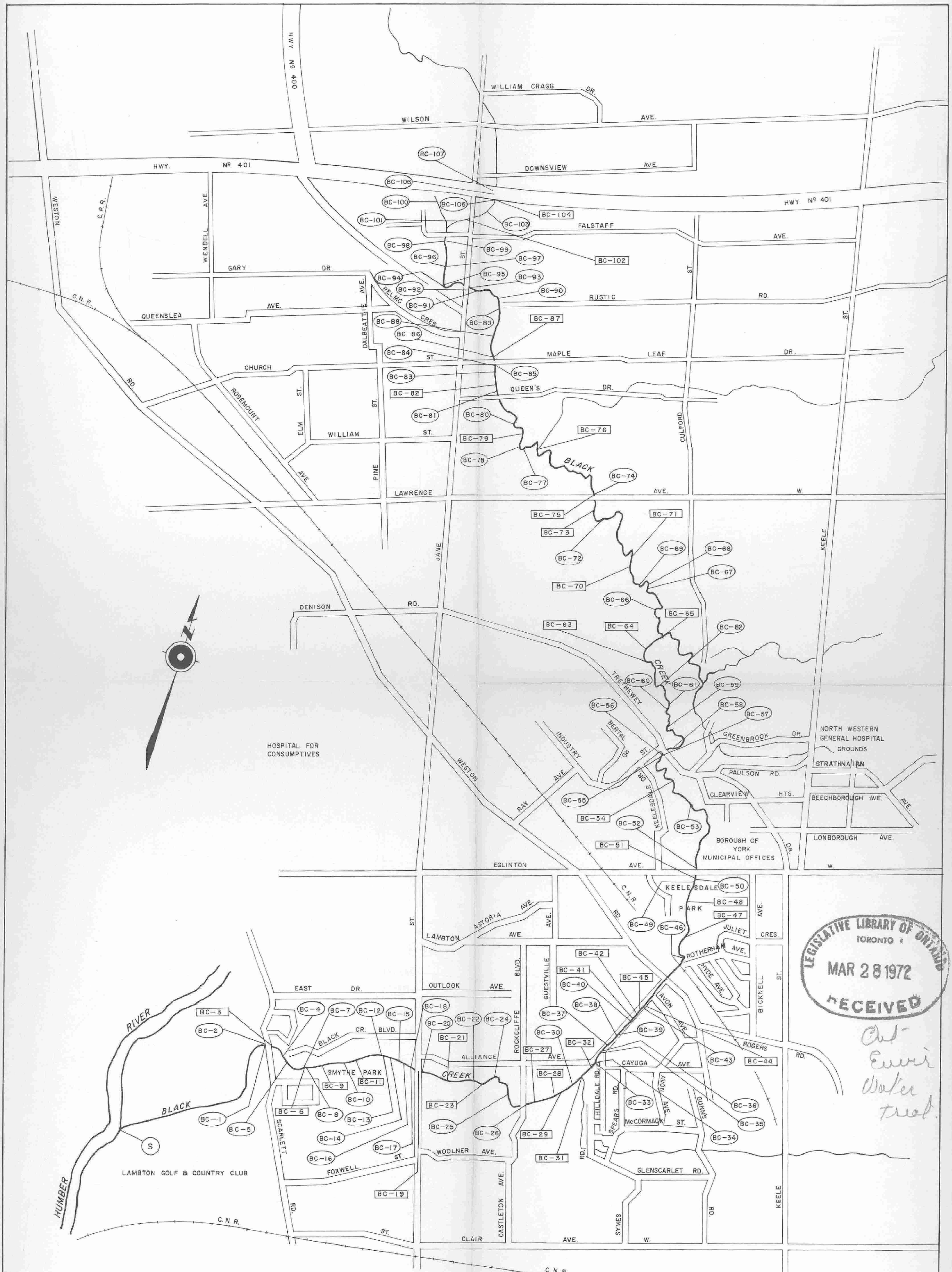
Storm Sewer - A sewer intended to carry storm wastes and relatively unpolluted discharges only, (i.e., cooling waters)

Solids - Suspended solids concentration is the concentration of suspended material in the water, dissolved solids that of the dissolved material, and total solids the sum of the two.




Out Envir Water treat

Water pollution survey Metro Toronto Humber River



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LEGEND

BC-19 — SAMPLING POINT (SAMPLED) OUTFALL SURVEY

BC-16 — SAMPLING POINT (NOT SAMPLED) OUTFALL SURVEY

S — SAMPLING POINT (SAMPLED) STREAM SURVEY

Water pollution survey
Metro Toronto
Humber River

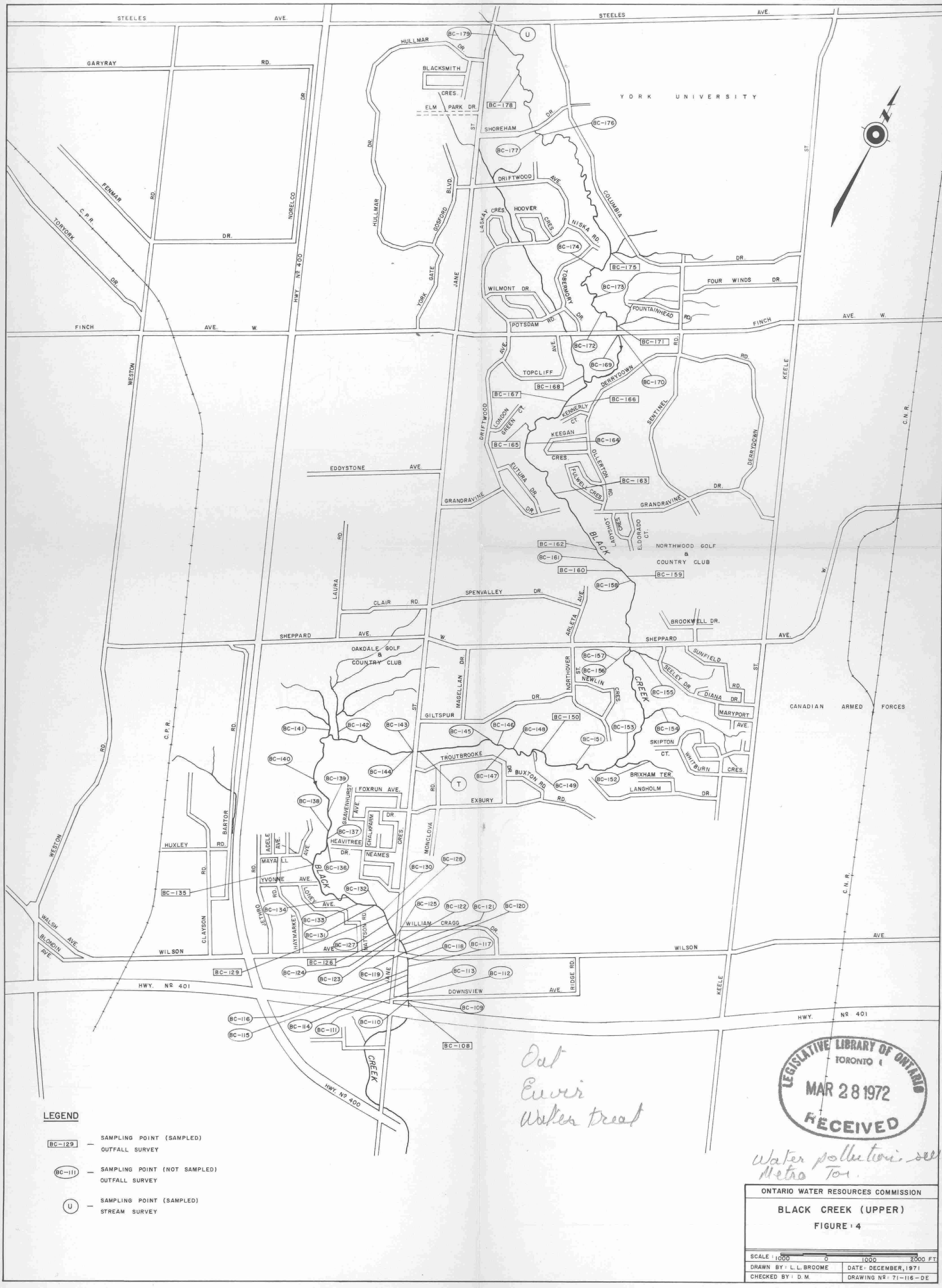
ONTARIO WATER RESOURCES COMMISSION

BLACK CREEK (LOWER)

FIGURE : 3

SCALE: 1000 0 1000 2000 FT.

| | |
|---|---|
| DRAWN BY: L.L. BROOME | DATE: DECEMBER, 1971 |
| CHECKED BY: D. M. | DRAWING Nº: 71-113-DE |

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Water pollution surv.
Metro Tor.


ONTARIO WATER RESOURCES COMMISSION

HUMBER RIVER (MAIN)

FIGURE: I

| | |
|---|---|
| SCALE: 1000 0 1000 2000 FT. | |
| DRAWN BY: L. L. BROOME | DATE: DECEMBER, 1971 |
| CHECKED BY: D. M. | DRAWING No: 71-110-DE |



Out Envir Water treat

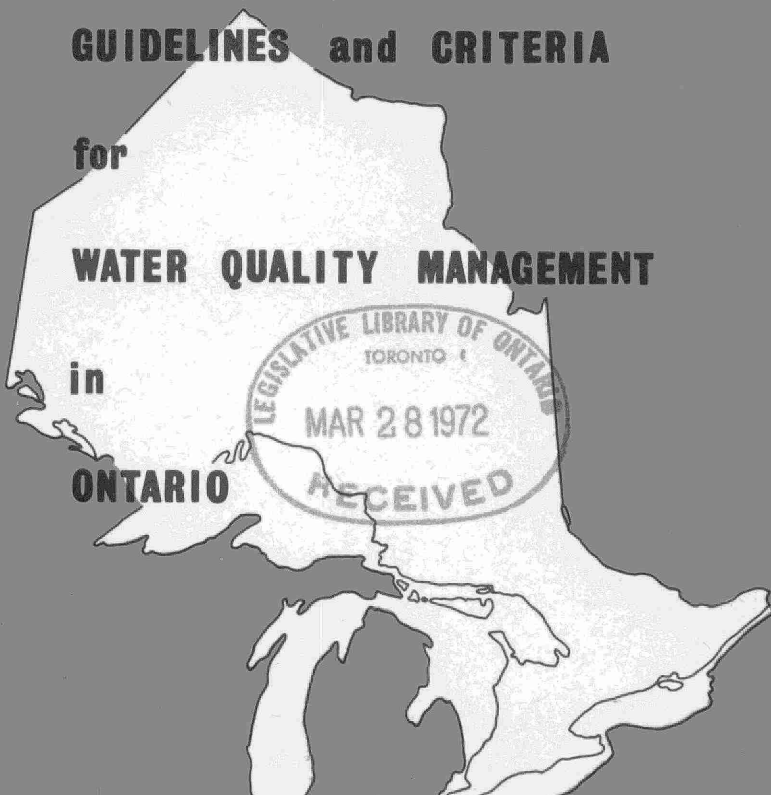
Water pollution survey Metro Toronto Humber River

Water management in Ontario

Ontario
Water Resources
Commission

June
1970

# GUIDELINES and CRITERIA for WATER QUALITY MANAGEMENT in ONTARIO



# GUIDELINES AND CRITERIA

FOR

# WATER QUALITY MANAGEMENT IN ONTARIO

BY THE


ONTARIO WATER RESOURCES COMMISSION

HON. GEORGE A. KERR, Q.C.
Minister

J. H. H. ROOT, M.P.P.
Vice-Chairman

R. D. JOHNSTON
Chairman



135 St. Clair Avenue W., Toronto 7, Ontario
June, 1970

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# INTRODUCTION

In 1967, the Ontario Water Resources Commission announced its Policy Guidelines for Water Quality Control in the Province of Ontario. This publication contains a re-statement of the guidelines and introduces water quality criteria for various uses including public, agricultural and industrial water supply, recreation, aesthetic enjoyment and the propagation of fish and wildlife. The use of water for assimilation and dilution of treated wastes must take into consideration these many desirable uses. Application of the criteria to water uses within the drainage basins of the province, or parts thereof, will lead to the development of water quality standards for the control of water pollution.

# GUIDELINES FOR THE CONTROL OF WATER QUALITY

1 The water resources of Ontario must meet many needs, some of which are in conflict. The standards established, therefore, must be based on the best interests of the people of Ontario. These interests require the preservation, and restoration where necessary, of the quality of our water for the greatest number of uses. The use of water for the assimilation and dilution of treated waste effluents must take into consideration the variety of uses, including public, agricultural and industrial supply, recreation, aesthetic enjoyment and the propagation of fish and wildlife.

2 For each use of water there are certain water quality characteristics, identified as criteria, which should be met to ensure that the water is suitable for that use.

3 Water quality standards will be established by the Ontario Water Resources Commission for waters of drainage basins or parts thereof with important water uses, following consultation with agencies or persons having an interest or responsibility in the present or future use of the water in the basin for which the standards are to be established.

4 Water of a higher quality than that required by the standards will be maintained at that higher quality unless in the public interest an alteration of the quality is consistent with the protection of all uses which are in accordance with the water quality standards established.

There should be a constant effort to improve the quality of water, for it is recognized that the improvement of the quality of water makes it available for more uses.

5 Requirements for effluents and land drainage based on the applicable water quality standards, or criteria where such standards do not exist, will be established by the Commission in order to maintain acceptable water quality. More stringent methods of control and/or treatment of waste inputs and land drainage may become necessary as the use of water changes or increases, or as standards are re-defined.

6 In establishing effluent requirements from water quality standards a reserve capacity of the receiving water should be set aside to provide an adequate margin of protection in recognition of the limitations of water management theory and practice.

7 All wastes prior to discharge to any receiving watercourse must receive the best practicable treatment or control. Such treatment must be adequate to protect and wherever possible upgrade water quality in the face of population and industrial growth, urbanization and technological change.

8 Criteria and standards of water quality and effluent requirements will be defined quantitatively only where sound numerical information is available; otherwise, they will be described in appropriate detail. They will be re-defined from time to time in the light of new evidence.

# WATER QUALITY CRITERIA

The following criteria for water quality are a set of numerical and descriptive characteristics, carefully defined, and applicable to each major water use category such as agriculture; fish, other aquatic life and wildlife; industrial water supply; public water supply; recreation and aesthetics. The criteria are described for use in establishing Water Quality Standards for drainage basins which in turn will be used to determine Effluent Requirements for discharges of wastes and land drainage.

The responsibility for demonstrating that a waste effluent is harmless to water uses in the concentrations to be found in the receiving waters, rests with those producing the discharge. Zones of passage and/or mixing adjacent to outfalls at the limit of which water quality may be critical, will be prescribed by the Commission.

Reference is frequently made in the Criteria to the Report of the Committee on Water Quality, Federal Water Pollution Control Administration, U.S. Department of the Interior (1968). Acknowledgement of the report is gratefully given in recognition of its basic reference value.

## ZONES OF PASSAGE AND MIXING

Mixing zones in the vicinity of outfalls should be restricted as much as possible in extent and should provide for the safe passage of both fish and free-floating and drift organisms. Every precaution should be taken to ensure that at least two-thirds of the total cross-sectional area of a river or stream is characterized by a quality which is entirely favourable to the aquatic community at all times. In most cases this would preclude the use of a diffuser outfall which would distribute effluent uniformly across the river or stream. The water quality standard which defines the acceptable concentration of a substance contained in a waste discharge will apply at the periphery of the mixing zone or other specified sampling location.

Within mixing zones, it should be recognized that toxic wastes which will not evoke an avoidance response on the part of fish or other organisms should not be permitted. Where toxic materials are being discharged it should be assumed that the various components in the waste, regardless of the form in which they are present, may eventually be altered to the most toxic form in the aquatic environment. Adequate treatment of all wastes should be provided and mixing zones should not be considered as a substitute for proper treatment.

## STATISTICAL PROBLEMS IN SETTING LIMITS

The systematic surveillance of water and waste sources requires the collection of data to clearly represent the problems being studied. The problems are many and varied. In one case the average condition over a period of time may be required and the question arises over what period shall the average or median be taken; in another, the limit may be a figure that should not be exceeded at any time. If a standard for a certain constituent is "none", the question arises "how small an amount does this mean?" The answers vary with the type of standard and the circumstances governing the fluctuation of the indicator. In ground water problems, only the average over a considerable period of time is significant. Where required in the setting of standards and effluent requirements, definitions of limits will include the applicable sampling conditions, quantitative values and rates of discharge.

## 1 WATER QUALITY CRITERIA FOR AGRICULTURAL USES (AGR)

Agricultural production requires water of suitable quality for a variety of uses. Criteria for the major uses are given under three headings: Dairy Sanitation, Livestock Watering, and Irrigation.

Requirements for domestic and other farmstead uses and the common requirements for dairy sanitation are given elsewhere in the criteria for Private Water Supplies and Public Water Supplies.

### AGR-1 Dairy Sanitation

Modern methods for bulk handling of milk on farms require large volumes of good quality water to ensure a premium product. The quality of water needed for good dairy sanitation requires criteria for certain parameters that are additional to, or more stringent than, those required for private water supplies. These are summarized under the headings "Permissible Criteria" and "Desirable Criteria". They should be used in conjunction with the criteria for public and private water supplies.

Treatment may prove satisfactory in meeting the criteria for certain of the inorganic chemicals such as iron and total hardness.

Waters that meet the desirable microbiological criteria can be used without disinfection; those meeting the permissible criteria require disinfection (chlorination), or chlorination and filtration, before use to reduce bacteria to levels where they will not cause deterioration of the quality of milk. Waters used for dairy sanitation should be sampled and tested at least monthly, in some cases daily, to ensure that they meet the microbiological criteria.

**TABLE AGR-1**

**Water Quality Criteria for Agricultural Uses**
**Dairy Sanitation**

| Constituent or Characteristic | Permissible Criteria | Desirable Criteria |
|---|---|---|
| Inorganic Chemicals: | | |
| Copper | 0.1 mg/l | |
| Iron | 0.1 mg/l | |
| pH (range) | 6.8 to 8.5 | |
| Potassium | 20 mg/l | |
| Total hardness as $CaCO_3$ | 150 mg/l | 100 mg/l |
| Microbiological: | | |
| Proteolytic and/or Lipolytic bacteria (20°C) (individual results) | 500/100 ml | 0/100 ml |
| Yeast | | Absent |
| Mould | | Absent |
| Physical: | | Clear<br>Colourless<br>Good taste |

## AGR-2 Livestock Watering

The health and productivity of livestock are affected by the quantities of various substances ingested as feed and as water. Accordingly, the amounts of certain substances that can be present without harm in water consumed by livestock will depend in part on the amounts of the same substances that are present in the feed in addition to a number of other factors which include: the daily water requirements and the species, age, and physiological condition of the animals, and the nature and quantities of other constituents of the feed and water.

Animals may be able to tolerate a fairly high level of total dissolved solids or bacteria if they are accustomed to such levels, but may be unable to tolerate a sudden change from waters with low dissolved solids or bacteria to waters with high dissolved solids or bacteria.

In addition to direct effects on the animals, certain substances may contaminate animal products to the point where they will not be acceptable for human consumption.

The variability of the factors that influence the acceptability of water for livestock-watering purposes must be considered when using the water quality criteria. Although the criteria provide a general guide to the quality of water that will be acceptable for most livestock, there may be cases where water of different quality than that indicated by the criteria will be required or acceptable because of the nature, age, or condition of species being raised or because of special rearing conditions or feed components. In such cases, or where the quality of an individual supply is in doubt, the quality should be assessed in relation to the specific use.

Water meeting the permissible criteria will be satisfactory for most livestock under normal rearing conditions. Water meeting the desirable criteria should provide a palatable and safe source for all normal livestock-watering purposes.

**TABLE AGR-2**
**Water Quality Criteria for Agricultural Uses**
**Livestock**

| Constituent or Characteristic | Permissible Criteria | Desirable Criteria |
|---|---|---|
| General Quality | | ideally should meet the desirable criteria for private water supplies. |
| Inorganic Chemicals: | | |
| Total Dissolved Solids | 2500 mg/l | < 500 mg/l |
| Arsenic | 0.05 mg/l | Absent |
| Cadmium | 0.01 mg/l | Absent |
| Chromium (hexavalent) | 0.05 mg/l | Absent |
| Fluoride | 2.4 mg/l | 1.2 mg/l |
| Lead | 0.05 mg/l | Absent |
| Nitrate plus Nitrite (as N) | 20 mg/l | < 10 mg/l |
| Selenium | 0.01 mg/l | Absent |
| Sulphate | 1000 mg/l | < 250 mg/l |
| Radioactivity: | | |
| Radium-226 | 3 pc/l | < 1 pc/l |
| Strontium-90 | 10 pc/l | < 2 pc/l |
| Gross beta activity in the known absence of strontium-90 and alpha-emitting radionuclides. | 1000 pc/l | < 100 pc/l |
| Microbiological: (1) | | |
| Enterococci (35°C) | < 40/100 ml | 0/100 ml |
| Algae | No heavy growth of blue-green algae | |

(1) The supply should be free of barnyard runoff and of effluent contamination from either man or animals. The geometric mean of sample results should not exceed the values given.

**AGR-3 Irrigation**

The suitability of water for irrigation cannot be defined precisely because the effects of the water on the crop being irrigated depend on many factors. These include: soil types, climatic conditions, irrigation practices, variations in the relation between the concentration and composition of the irrigation water and the soil solution, variations in the tolerance of different plants to the combined or individual constituents in the irrigation water or the soil solution, and the modifying effects of interrelations between and among the constituents. In general, for satisfactory irrigation, soils with poor drainage characteristics require water of higher quality than better drained soils.

In humid areas, excessive concentrations of salts or individual elements will normally be leached from the soil during periods of heavy rainfall or snowmelt before or after the growing season. This leaching action is another factor affecting the quality of water that can be used for irrigation. It may allow the use of water of poorer quality than that listed in these criteria for some crops and conditions without serious detrimental effects. Also through proper timing and adjustment of frequency and volumes of water applied, detrimental effects of poorer quality water may often be mitigated. Good drainage of soil may be a factor of similar importance as the quality of the water used.

The presence of sediment, pesticides, or pathogenic organisms in irrigation water, which may not specifically affect plant growth, may affect the acceptability of the product. Larger sediment particles could lead to plugging of sprinkler nozzles.

Although there are many variations in the quality of water that is suitable for specific irrigation uses, water quality criteria have been assembled as a guide to the quality of water that will meet many irrigation needs. The criteria are listed as permissible and desirable. Water meeting the desirable criteria should be satisfactory for irrigation of most crops in most soil types for long periods of time. Water meeting the permissible criteria, while suitable for many crops, soil and climatic conditions, could result in decreased yields for some crops if it is used repeatedly, unless there is dilution or leaching by precipitation or the application of excess irrigation water under favourable drainage conditions. Special crops or conditions, such as the growing of plants in greenhouses, may require irrigation with water of higher quality than that indicated by the desirable criteria.

The suitability of a given source of water for specific crops, soil types, and climatic conditions should be judged on an individual basis if its suitability has not been demonstrated by practice.

## TABLE AGR-3

### Water Quality Criteria for Agricultural Uses
### Irrigation

| Constituent or Characteristic | Permissible Criteria | Desirable Criteria |
|---|---|---|
| Physical: | | |
| Temperature | | 55°F to 85°F |
| Microbiological: (1) | | |
| Fecal Coliforms (44.5°C) | 100/100 ml | 0/100 ml |
| Enterococci (35°C) | 20/100 ml | 0/100 ml |
| Total bacteria (20°C) | 100,000/100 ml | < 10,000/100 ml |
| Inorganic Chemicals: | | |
| Aluminum | 20.0 mg/l | < 1.0 mg/l |
| Arsenic | 10.0 mg/l | < 1.0 mg/l |
| Beryllium | 1.0 mg/l | < 0.5 mg/l |
| Boron | 0.5 mg/l | 0.3 mg/l |
| Cadmium | 0.05 mg/l | < 0.005 mg/l |
| Chloride | 150 mg/l | < 70 mg/l |
| Chloride—special requirement for tobacco | 70 mg/l | < 20 mg/l |
| Chromium | 20.0 mg/l | < 5.0 mg/l |
| Cobalt | 10.0 mg/l | < 0.2 mg/l |
| Copper | 5.0 mg/l | < 0.2 mg/l |
| Lead | 20.0 mg/l | < 5.0 mg/l |
| Lithium | 5.0 mg/l | < 5.0 mg/l |
| Manganese | 20.0 mg/l | < 2.0 mg/l |
| Molybdenum | 0.05 mg/l | < 0.005 mg/l |
| Nickel | 2.0 mg/l | < 0.5 mg/l |
| pH (range) | 4.8 to 9.0 | |
| Residual Sodium Carbonate $=(CO_3^{--}+HCO_3^{-})-(Ca^{++}+Mg^{++})$ expressed as mg eq/l | 1.25 mg eq/l | < 1.25 mg eq/l |
| Selenium | 0.05 mg/l | < 0.05 mg/l |
| Sodium Adsorption Ratio $=\dfrac{Na^{+}}{\sqrt{\dfrac{Ca^{++}+Mg^{++}}{2}}}$ expressed as mg eq/l | 6 | < 4 |
| Total dissolved solids | | |
| Vanadium | 500 mg/l | < 200 mg/l |
| Zinc | 10.0 mg/l | < 10.0 mg/l |
| | 5.0 mg/l | < 5.0 mg/l |
| Organic Chemicals: | | |
| Pesticides | Insecticides, herbicides, fungicides, and rodenticides must not be present in waters used for irrigation in concentrations that are detrimental to crops, livestock, wildlife or man. | Absent |

(1) The geometric mean of sample results should not exceed the values given.

## 2 WATER QUALITY CRITERIA FOR THE PROTECTION OF FISH, OTHER AQUATIC LIFE AND WILDLIFE (F & W)

The following criteria are considered to be satisfactory for fish, other aquatic life and wildlife. Reference is made to aspects of water quality considered to be most important in the light of current knowledge. Narrative guidelines are offered where quantification is not yet possible.

### Dissolved Materials

Dissolved materials should not be added to increase the concentration of dissolved solids by more than one-third of the natural condition of the receiving water, owing to potentially harmful osmotic effects of high concentrations. Dissolved materials that are harmful in relatively low concentrations are discussed in the section "Toxic Substances".

### pH, Alkalinity, Acidity

(1) pH should be maintained within a range of 6.5 to 8.5.

(2) To protect the carbonate system, and thus the productivity of the water, acid should not be added in sufficient quantity to lower the total alkalinity to less than 20 mg/l.

### Temperature

(1) **General**

Unless a special study shows that discharge of a heated effluent into the hypolimnion of a lake will be desirable, such practice is not recommended and water for cooling should not be pumped from the hypolimnion to be discharged to the same body of water.

The normal daily and seasonal temperature variations that were present before the addition of heat due to other than natural causes should be maintained.

Wherever possible, heated discharges should be located where elevated temperature will enhance public utilization of the water by supporting a wider variety of water uses.

(2) **Great Lakes and Connecting Waters**

(a) Heated discharges are not permitted that may stimulate production of nuisance organisms or vegetation or that are or may become injurious to wildlife, waterfowl, fish or other aquatic life or the growth and reproduction thereof. For each discharge of a heated effluent, acceptable mixing zones will be established on the basis of features and facts pertinent to that specific situation.

(b) Heat may not be discharged in the vicinity of spawning areas or where increased water temperature might interfere with recognized movements of spawning or migrating fish populations.

(3) **Inland Waters**

(a) Heated discharges to inland waters will not be permitted unless it is clearly demonstrated that heated effluents will enhance the usefulness of the water resource without endangering the production and optimum maintenance of wildlife, fish and other aquatic species. It shall be the responsibility of the user to provide evidence to support the acceptability of the discharge under these terms.

(b) Inland trout streams, salmon streams, trout and salmon lakes and the hypolimnion of lakes and reservoirs containing salmonids and other cold water forms should not be warmed.

(c) Heat may not be discharged in the vicinity of spawning areas or where increased temperature might interfere with recognized movements of spawning or migrating fish populations.

### Dissolved Oxygen

(1) **Warm-water Biota**

The dissolved oxygen (DO) concentration should be above 5 mg/l at all times, except that in certain situations concentrations may range between 5 and 4 mg/l for short intervals within any 24-hour period provided that water quality is favourable in all other respects.

(2) **Cold-water Biota**

In spawning areas, DO levels must not be below 7 mg/l at any time. Elsewhere, DO concentrations should not be below 6 mg/l. In certain situations, they may range between 6 and 5 mg/l for short intervals within any 24-hour period, provided the water quality is favourable in all other respects.

### Carbon Dioxide

The 'free' carbon dioxide concentration should not exceed 25 mg/l.

### Oil

Oil, petrochemicals or other immiscible substances that will cause visible films or toxic, noxious or nuisance conditions should not be added to water.

### Turbidity

(1) Turbidity associated with waste inputs should not exceed 50 Jackson units in warm-water streams or 10 Jackson units in cold-water streams.

(2) There should be no discharge which would cause turbidities exceeding 25 Jackson units in warm-water lakes or 10 Jackson units in cold-water or oligotrophic lakes.

**Settleable Materials**

Substances should not be added that will adversely affect the aquatic biota or will create objectionable deposits on the bottom or shore of any body of water.

**Colour and Transparency**

For effective photosynthetic production of oxygen, it is required that 10 per cent of the incident light reach the bottom of any desired photosynthetic zone in which adequate dissolved oxygen concentrations are to be maintained.

**Floating Materials**

All floating materials, other than those of natural origin, should be excluded from streams and lakes.

**Tainting substances**

All materials that will impart odour or taste to fish or edible invertebrates should be excluded from receiving waters at levels that produce tainting.

**Radionuclides**

Radioactive materials should not be present in natural waters as a consequence of failure to exercise necessary controls of radioactivity releases to keep exposure to a minimum.

Experience has shown that standards established for drinking water assure that people will receive no more than currently acceptable amounts of radioactive materials from aquatic sources and that fish and other aquatic life will not receive an injurious dose of radiation.

Thus, present standards accepted for the protection of fish and other aquatic life are as follows:

| | pc/l |
|---|---|
| Gross beta emitters | 1000 |
| Radium-226 | 3 |
| Strontium-90 | 10 |

Where other radioisotopes occur, the significance of the exposure of aquatic species to these forms of radiation should be assessed for each situation, both with respect to potential damage to the organisms themselves and to humans where fish or other edible forms are utilized.

**Plant Nutrients and Nuisance Growths**

(1) Nutrients from unnatural sources that will stimulate production of algae, nuisance vegetation or offensive slime growths should not be added to water. The addition of sulphates or manganese oxide to a lake should be limited if iron is present in the hypolimnion as these substances may increase the quantity of available phosphorus.

(2) Organic or other materials that will promote an increased zone of anaerobic decomposition within a lake, reservoir or other body of water should not be allowed to enter the water.

(3) The naturally-occurring ratios of nitrogen (particularly $NO_3$ and $NH_4$) to total phosphorus, and their amounts, should not be radically changed by the addition of materials from waste sources and land drainage.

**Toxic Substances**

Toxic substances must not be added to water in concentrations or combinations that are toxic or harmful to human, animal, plant or aquatic life, except where the application of approved substances for the control of nuisance organisms has been authorized by the Commission (Section 28b, OWRC Act).

The evaluation of toxicity for aquatic organisms is based on use of the TLm or median tolerance limit. This represents the concentration at which half the test organisms will succumb over a given period of exposure such as 24, 48 or 96 hours. It does not, therefore, represent the safe concentration and an application factor is applied to ensure a safe condition, including allowance for sub-lethal effects.

(1) **Substances of Unknown Toxicity**

All effluents containing foreign materials should be considered harmful and not permissible until bioassay tests have shown otherwise. The onus for demonstrating that an effluent is harmless in the concentrations to be found in the receiving waters rests with those responsible for the discharge. Information concerning acceptable bioassay procedures is available from the Commission.

(2) **Application Factors**

Concentration of materials that are non-persistent (that is, have a half-life of less than 96 hours), or have non-cumulative effects after mixing with the receiving waters, should not exceed 1/10 of the applicable 96-hour TLm value at any time or place based on species representative of local conditions. The 24-hour average of the concentration of these materials should not exceed 1/20 of the TLm value after mixing. For other toxicants, the concentrations should not exceed 1/20 and 1/100 of the TLm value under the aforementioned conditions.

(3) **Additive Effects**

When two or more toxic materials that have additive effects are present at the same time in the receiving water, some reduction is necessary in the permissible concentrations as derived from bioassays on individual substances or wastes. The amount of reduction required is a function of both the number of toxic materials present and their concentrations in respect to the derived permissible concentration. An appropriate means of assuring that the combined

amounts of the several substances do not exceed a permissible concentration for the mixture is through the use of the following relationship:

$$\left(\frac{C_a}{L_a} + \frac{C_b}{L_b} \ldots + \frac{C_n}{L_n} \leq 1\right)$$

where $C_a$, $C_b$, ....... $C_n$ are the measured concentrations of the several toxic materials in the water and $L_a$, $L_b$, .......... $L_n$ are the respective permissible concentration limits derived for the materials on an individual basis. Should the sum of the several fractions exceed one, then a local restriction on the concentration of one or more of the substances is necessary.

(4) **Pesticides**

(a) Chlorinated Hydrocarbons:

Any addition of chlorinated hydrocarbon insecticides is likely to cause damage to some desired organisms and their use should be avoided.

(b) Other Chemical Pesticides:

Other pesticides and herbicides gaining access to water can cause damage to desirable organisms and should be used with utmost discretion and caution. Tables F & W-1 and F & W-2 list the 48-hour TLm values of a number of pesticides for various types of fresh water organisms. To provide reasonably safe concentrations of these materials in receiving waters, application factors ranging from 1/10 to 1/100 should be used, with these values depending on the characteristic of the pesticide in question and used as specified in (2) above. Concentrations thus derived may be considered tentatively safe under the conditions specified. TLm values and related application factors are subject to revision as additional bioassay information is obtained for species which may be more representative of local conditions.

(5) **Other Toxic Substances**

(a) ABS: The concentration of ABS should not exceed 1/7 of the 48-hour TLm at any time or place.

(b) LAS: The concentration of LAS should not exceed 1/7 of the 48-hour TLm at any time or place.

(c) ARSENIC: An application factor of 1/100 should be applied to the 96-hour TLm value as a tentative safe concentration for continuous exposure. An environmental level of .01 mg/l should not be exceeded under any circumstances.

(d) AMMONIA: Permissible concentrations of ammonia should be determined by the flow-through bioassay with the pH of the test solution maintained at 8.5, DO concentrations between 4 and 5 mg/l, and temperatures near the upper allowable levels.

(e) CADMIUM: The concentration of cadmium must not exceed 1/500 of the 96-hour TLm concentration at any time or place.

(f) CHROMIUM: The concentration of chromium should not exceed 1/100 of the 96-hour TLm at any time or place.

(g) COPPER: The maximum copper (expressed as Cu) concentration at any time or place shall not be greater than 1/12 of the 96-hour TLm value. The maximum permissible concentration for continuous exposure is between 3 per cent and 7 per cent of the 96-hour TLm.

(h) LEAD: The concentration of lead should not exceed 1/20 of the 96-hour TLm at any time or place and the 24-hour average should not exceed 1/100 of the 96-hour TLm concentration after mixing.

(i) MERCURY: Owing to demonstrated cumulative effects of mercury in fish, and the attendant hazard to other animals, discharges of mercury to water should be avoided.

(j) NICKEL: The concentration of nickel should not exceed 1/50 of the 96-hour TLm concentration at any time or place.

(k) ZINC: The concentration of zinc should not exceed 1/100 of the 96-hour TLm concentration at any time or place.

## TABLE F & W-1 INSECTICIDES*

(48-hour TLm values from static bioassay, in micrograms per litre. Exceptions are noted.)

| Pesticide | Stream Invertebrate[1] Species | Stream Invertebrate[1] TLm | Cladocerans[2] Species | Cladocerans[2] TLm | Fish[3] Species | Fish[3] TLm | Gammarus Lacustris,[4] TLm |
|---|---|---|---|---|---|---|---|
| Abate | Pteronarcys californica | 100 | | | Brook trout | 1,500 | 640 |
| Aldrin[5] | P. californica | 8 | Daphnia pulex. | 28 | Rainbow trout | 3 | 12,000 |
| Allethrin | P. californica | 28 | D. pulex | 21 | - do - | 19 | 20 |
| Azodrin | | | | | - do - | 7,000 | |
| Aramite | | | D. magna | 345 | Bluegill | 35 | 100 |
| Baygon[5] | P. californica | 110 | | | Fathead | 25 | 50 |
| Baytex[5] | P. californica | 130 | Simocephalus serrulatus | 3.1 | Brown t. | 80 | 70 |
| Benzene hexachloride (lindane) | P. californica | 8 | D. pulex | 460 | Rainbow t. | 18 | 88 |
| Bidrin | P. californica | 1900 | D. pulex | 600 | - do - | 8,000 | 790 |
| Carbaryl (sevin) | P. californica | 1.3 | D. pulex | 6.4 | Brown t. | 1,500 | 22 |
| Carbophenothion (trithion) | | | D. magna | 0.009 | Bluegill | 225 | 28 |
| Chlordane[5] | P. californica | 55 | S. serrulatus | 20 | Rainbow t. | 10 | 80 |
| Chlorobenzilate | | | S. serrulatus | 550 | - do - | 710 | |
| Chlorthion | | | D. magna | 4.5 | | | |
| Coumaphos | | | D. magna | 1 | | | 0.14 |
| Cryolite | | | D. pulex | 5,000 | Rainbow t. | 47,000 | |
| Cyclethrin | | | D. magna | 55 | | | |
| DDD (TDE)[5] | P. californica | 1100 | D. pulex | 3.2 | Rainbow t. | 9 | 1.8 |
| DDT[5] | P. californica | 19 | D. pulex | 0.36 | Bass | 2.1 | 2.1 |
| Delnav (dioxathion) | | | | | Bluegill | 14 | 690 |
| Delmeton (systex) | | | | 14 | - do - | 81 | |
| Diazinon[5] | P. californica | 60 | D. pulex | 0.9 | - do - | 30 | 500 |
| Dibrom (naled) | P. californica | 16 | D. pulex | 3.5 | Brook t. | 78 | 160 |
| Dieldrin[5] | P. californica | 1.3 | D. pulex | 240 | Bluegill | 3.4 | 1,000 |
| Dilan | | | D. magna | 21 | - do - | 16 | 600 |
| Dimethoate (cygon) | P. californica | 140 | D. magna | 2500 | - do - | 9600 | 400 |
| Dimethrin | | | | | Rainbow t. | 700 | |
| Dichlorvos[5] (DDVP) | P. californica | 10 | D. pulex | 0.07 | Bluegill | 700 | 1 |
| Disulfoten (di-syston) | P. californica | 18 | | | - do - | 40 | 70 |

* From Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, U.S. Department of the Interior (1968).

TABLE F & W-1—continued

| Pesticide | Stream Invertebrate[1] Species | TLm | Cladocerans[2] Species | TLm | Fish[3] Species | TLm | Gammarus Lacustris,[4] TLm |
|---|---|---|---|---|---|---|---|
| Dursban | Peteronareella badia | 1.8 | | | Rainbow t. | 20 | 0.4 |
| Endosulfan (thiodan) | P. californica | 5.6 | D. magna | 240 | - do - | 1.2 | 64 |
| Endrin[5] | P. californica | 0.8 | D. pulex | 20 | Bluegill | 0.2 | 4.7 |
| EPH | | | D. magna | 0.1 | - do - | 17 | 36 |
| Ethion | P. californica | 14 | D. magna | 0.01 | - do - | 230 | 3.2 |
| Ethyl guthion[5] | | | D. pulex | | Rainbow t. | | |
| Fenthion | P. californica | 39 | D. pulex | 4 | | | |
| Guthion[5] | P. californica | 8 | D. magna | 0.2 | Rainbow t. | 10 | 0.3 |
| Heptachlor[5] | P. badia | 4 | D. pulex | 42 | - do - | 9 | 100 |
| Kelthane (dicofel) | P. californica | 3000 | D. magna | 390 | - do - | 100 | |
| Kepone | | | | | - do - | 37.5 | |
| Malathion[5] | P. badia | 6 | D. pulex | 1.8 | Brook t. | 19.5 | 1.8 |
| Methoxychlor[5] | P. californica | 8 | D. pulex | 0.8 | Rainbow t. | 7.2 | 1.3 |
| Methyl parathion[5] | | | D. magna | 4.8 | Bluegill | 8000 | |
| Morestan | P. californica | 40 | | | - do - | 96 | |
| Ovex | P. californica | 1500 | | | - do - | 700 | |
| Paradichlorobenzene | | | | | Rainbow t. | 880 | |
| Parathion[5] | P. californica | 11 | D. pulex | 0.4 | Bluegill | 47 | 6 |
| Perthane | | | D. magna | 9.4 | Rainbow t. | 7 | |
| Phosdrin[5] | P. californica | 9 | D. pulex | 0.16 | - do - | 17 | 310 |
| Phosphamidon | P. californica | 460 | D. magna | 4 | - do - | 8000 | 3.8 |
| Pyrethrins | P. californica | 64 | D. pulex | 25 | - do - | 54 | 18 |
| Rotenone | P. californica | 900 | D. pulex | 10 | Bluegill | 22 | 350 |
| Strobane[5] | P. californica | 7 | | | Rainbow t. | 2.5 | |
| Tetradifon (tedion) | | | | | Bluegill | 1100 | 140 |
| TEPP[5] | | | | | Fathead | 390 | 52 |
| Thanite | | | D. magna | 450 | | | |
| Thimet | | | | | Bluegill | 5.5 | 70 |
| Toxaphene[5] | P. californica | 7 | D. pulex | 15 | Rainbow t. | 2.8 | 70 |
| Trichlorofon (dipterex)[5] | P. badia | 22 | D. magna | 8.1 | - do - | 160 | 60 |
| Zectran | P. californica | 16 | D. pulex | 10 | - do - | 8000 | 76 |

TABLE F & W-2

HERBICIDES, FUNGICIDES, DEFOLIANTS, ALGICIDES*

| Pesticide | Stream Invertebrate[1] | | Cladocerans[2] | | Fish[3] | | Gammarus Lacustris,[4] |
|---|---|---|---|---|---|---|---|
| | Species | TLm | Species | TLm | Species | TLm | TLm |
| Ametryne | | | | | Rainbow t. | 3400 | |
| Aminotriazole | | | | | | | |
| Aquathol | | | | | Bluegill | 257 | |
| Atrazine | | | Daphnia magna | 3600 | Rainbow t. | 12,600 | |
| Azide, potassium | | | | | Bluegill | 1400 | 10,000 |
| Azide, sodium | | | | | - do - | 980 | 9000 |
| Copper chloride | | | | | - do - | 1100 | |
| Copper sulphate | | | | | - do - | 150 | |
| Dichlobenil | Pteronarcys californica | 44,000 | Daphnia pulex | 3700 | - do - | 20,000 | 1500 |
| 2,4-D PGBEE | | | D. pulex | 3200 | Rainbow t. | 960 | 1800 |
| 2,4-D BEE | P. californica | 1800 | | | Bluegill | 2100 | 760 |
| 2,4-D isopropyl | | | | | - do - | 800 | |
| 2,4-D butyl ester | | | | | - do - | 1300 | |
| 2,4-D butyl + isopropyl ester | | | | | - do - | 1500 | |
| 2,4,5-T isooctyl ester | | | | | - do - | 16,700 | |
| 2,4,5-T isopropyl ester | | | | | - do - | 1700 | |
| 2,4,5-T PGBE | | | | | - do - | 560 | |
| 2(2,4-DP) BEE | | | | | - do - | 1100 | |
| Dalapon | P. californica Very low toxicity | | D. magna | 6000 | | Very Low Toxicity | |
| Dead-X | P. californica | 5000 | D. pulex | 3700 | Rainbow t. | 9400 | 5600 |
| DEF | P. californica | 2300 | | | Bluegill | 36 | 230 |
| Dexon | P. californica | 42,000 | | | Bluegill | 23,000 | 6000 |
| Dicamba | | | | | non-toxic | | 5800 |
| Dichlone | | | D. magna | 26 | Rainbow t. | 48 | 11,500 |
| Difolitan | P. californica | 150 | | | Channel Cat | 31 | 6500 |
| Dinitrocresol | P. californica | 560 | | | Rainbow t. | 210 | |
| Diquat | | | | | Rainbow t. | 12,300 | |
| Diuron | P. californica | 2800 | D. pulex | 1400 | - do - | 4300 | 380 |
| Du-ter | | | | | Bluegill | 33 | |
| Dyrene | | | D. magna | 490 | | 15 | |
| Endothal, copper | | | | | Rainbow t. | 290 | |

* From Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, U.S. Department of the Interior (1968).

TABLE F & W-2—continued

| Pesticide | Stream Invertebrate[1] Species | TLm | Cladocerans[2] Species | TLm | Fish[3] Species | TLm | Gammarus Lacustris,[4] TLm |
|---|---|---|---|---|---|---|---|
| Endothal dimethylamine | | | | | Rainbow t. | 1150 | |
| Fenac, acid | P. californica | 70,000 | | | - do - | 16,500 | |
| Fenac, sodium | P. californica | 80,000 | D. pulex | 4500 | - do - | 7500 | 18,000 |
| Hydram (molinate) | P. californica | 3500 | | | - do - | 290 | |
| Hydrothol 191 | | | | | - do - | 690 | 1000 |
| Lanstan (Korax) | | | | | - do - | 100 | 5500 |
| LFN | | | | | - do - | 79 | |
| Paraquat | P. californica Very low toxicity | | D. pulex | 3700 | Very low toxicity | | 18,000 |
| Propazine | | | | | Rainbow t. | 7800 | |
| Silvex, PGBEE | | | D. pulex | 2000 | - do - | 650 | |
| Silvex, isoctyl | | | | | Bluegill | 1400 | |
| Silvex, BEE | | | | | - do - | 1200 | |
| Simazine | P. californica | 50,000 | | | Rainbow t. | 5000 | 21,000 |
| Sodium arsenite | P. californica Very low toxicity | | Simocephalus serrulatus | 1400 | - do - | 36,500 | |
| Tordon (picloram) | | | | | - do - | 2500 | 48,000 |
| Trifuralin | P. californica | 4200 | D. pulex | 240 | - do - | 11 | 5600 |
| Vernam[5] (vernolate) | | | | | - do - | 5900 | 25,000 |

1 Stonefly bioassay was done at Denver, Colo., and at Salt Lake City, Utah. Denver tests were in soft water (35 mg/l TDS), non-aerated, 60 F. Salt Lake City tests were in hard water (150 mg/l TDS), aerated, 48-50 F. Response was death.

2 Daphnia pulex and Simocephalus serrulatus bioassay was done at Denver, Colo., in soft water (35 mg/l TDS), non-aerated, 60 F. Daphnia magna bioassay was done at Pennsylvania State University in hard water (146 mg/l TDS), non-aerated, 68 F. Respone was immobilization.

3 Fish bioassay was done at Denver, Colo., and at Rome N.Y. Denver tests were with 2-inch fish in soft water (35 mg/l TDS), non-aerated, trout at 55 F.; other species at 65 F. Rome tests were with 2-2½ inch fish in soft water (6 mg/l TA: pH 5.85-6.4), 60 F. Response was death.

4 Gammarus bioassay was done at Denver, Colo., in soft water (35 mg/l TDS), non-aerated, 60 F. Response was death.

5 Becomes bound to soil when used according to directions, but highly toxic (reflected in numbers) when added directly to water.

## 3 WATER QUALITY CRITERIA FOR INDUSTRIAL WATER SUPPLIES (IWS)

Desired water quality criteria are tabled for the major industrial classifications as follows:

| | |
|---|---|
| Brewing and Soft Drinks | — IWS-1 |
| Chemical and Allied Products | — IWS-2 |
| Industrial Cooling | — IWS-3 |
| Food Processing | — IWS-4 |
| Electroplating and Metal Finishing | — IWS-5 |
| Iron and Steel | — IWS-6 |
| Petroleum | — IWS-7 |
| Pulp and Paper | — IWS-8 |
| Leather Tanning and Finishing | — IWS-9 |
| Textiles | — IWS-10 |

While the values listed should not normally be exceeded, these water quality criteria can vary considerably for the same industrial process depending on factors such as the technological age of plant design.

A raw surface water and/or ground water supply which is used by many different industries may not satisfy the widely varying criteria for each use. However, water treatment technology in its present state of development permits the utilization of surface water of literally any available quality to produce water of any desired quality at the point of use in industry.

Most industries located on municipal water supply systems find the quality of water provided to be satisfactory. If the water quality requirements of an industry are such that water of higher quality than that provided by the municipality is required for specific process use, the industry generally accepts the additional costs involved to produce the higher quality water.

### TABLE IWS-1

### WATER QUALITY CRITERIA FOR THE BREWING AND SOFT DRINK INDUSTRIES

(Unless otherwise indicated, units are mg/l)

| Characteristic | Concentration |
|---|---|
| Alkalinity ($CaCO_3$) | 85 |
| pH, units | (1) |
| Hardness ($CaCO_3$) | (1) |
| Chloride (Cl) | 250(2) |
| Sulphate ($SO_4$) | 250(2) |
| Iron (Fe) | 0.3(3) |
| Manganese (Mn) | 0.05 |
| Fluoride (F) | 1(3) |
| Dissolved solids | (1) |
| Organics: carbon chloroform extract (CCE) | 0.15(3) |
| Coliform bacteria, count/100 ml | (3) |
| Colour, units | 5(4) |
| Taste, threshold number | (4, 5) |
| Odour, threshold number | (4, 5) |

(1) Controlled by treatment for other constituents.
(2) For brewing, value should not exceed 100 mg/l.
(3) Not greater than OWRC Drinking Water Objectives.
(4) In general, public water supplies are given conventional treatment such as coagulation, filtration and chlorination. Any additional requirement for higher quality, for example, deionized water, is the responsibility of the industry. To ensure low organic content, activated carbon treatment is used by industry.
(5) Zero, not detectable by test.

### TABLE IWS-2

### WATER QUALITY CRITERIA FOR THE CHEMICAL AND ALLIED PRODUCTS INDUSTRIES*

(Unless otherwise indicated, units are mg/l)

| Characteristic | Concentration[1] |
|---|---|
| Alkalinity (as $CaCO_3$) | 150 |
| Iron (Fe) | 0.3 |
| Manganese (Mn) | 0.1 |
| Calcium (Ca) | 50 |
| Magnesium (Mg) | 25 |
| Bicarbonate ($HCO_3$) | 250 |
| Sulphate ($SO_4$) | 250 |
| Chloride (Cl) | 250 |
| Nitrate ($NO_3$) as N | 10 |
| Hardness (as $CaCO_3$) | 250 |
| pH, units | 6.5-8.5 |
| Dissolved solids | 750 |
| Silica | 50 |
| Colour, units | 20 |
| Suspended solids | 15 |

* Industries include the manufacture of synthetic rubber, plastics, fertilizers, soap and detergents, organic and inorganic chemicals, etc.

(1) Because of the varying requirements of the many uses in the vast number of chemical industries, more stringent restrictions are placed on several of the above noted characteristics. In some cases, any concentration can be handled, while in others, the raw water is accepted as received provided it meets total solids or other limiting values. The above concentrations are suggested guidelines that should be suitable for the majority of uses in the chemical industry.

### TABLE IWS-3

### WATER QUALITY CRITERIA FOR COOLING WATER*

(Unless otherwise indicated, units are mg/l)

| Characteristic | Concentration |
|---|---|
| Turbidity | 50 |
| Hardness | 50 |
| Iron | 0.5 |
| Manganese | 0.5 |

Cooling waters should have appropriate initial temperatures and should not deposit scale, be corrosive or encourage the growth of slimes. Among the constituents of natural water that may prove detrimental to its use for cooling purposes are hardness, suspended solids, dissolved gases, acids, oil and other organic compounds and slime-forming organisms.

### TABLE IWS-4

### WATER QUALITY CRITERIA FOR THE FOOD PROCESSING INDUSTRY

(Unless otherwise indicated, units are mg/l)

| Characteristic | Concentration |
|---|---|
| Alkalinity ($CaCO_3$) | 150 |
| pH, units | 6.5-8.5 |
| Hardness ($CaCO_3$) | 150 |
| Chloride (Cl) | 250 |
| Sulphate ($SO_4$) | 250 |
| Iron (Fe) | 0.2 |
| Manganese (Mn) | 0.2 |
| Chlorine (Cl) | (1) |
| Fluoride (F) | 1(2) |
| Silica ($SiO_2$) | 50 |
| Phenol | (3, 4) |
| Nitrate ($NO_3$) as N | 10(2) |
| Nitrite ($NO_2$) as N | (3) |
| Organics: | |
| Carbon chloroform extract (CCE) | 0.15 |
| Odour, threshold number | (3) |
| Taste, threshold number | (3) |
| Turbidity | (6) |
| Colour, units | 5 |
| Dissolved solids | 500 |
| Suspended solids | 10 |
| Coliform, count/100 ml | (6) |
| Total bacteria, count/100 ml | (7) |

(1) Process waters for food canning are purposely chlorinated to a selected, uniform level. An unchlorinated supply must be available for preparation of canning syrups.

(2) Waters used in the processing and formulation of foods for babies should be low in fluorides concentration. Also, because high nitrate intake is alleged to be involved in infant illnesses, the concentration of nitrates in waters used for processing baby foods should be low.

(3) Zero, not detectable by test.

(4) Because chlorination of food processing waters is a desirable and widespread practice, the phenol content of intake waters must be considered. Phenol and chlorine in water can react to form chlorophenol, which even in trace amounts can impart a medicinal off-flavour to foods.

(5) Maximum permissible concentration may be lower depending on type of substance and its effect on odour and taste.

(6) As required by OWRC Drinking Water Objectives.

(7) The total bacterial count must be considered as a quality requirement for waters used in certain food processing operations. Other than aesthetic considerations, high bacterial concentration in waters coming in contact with frozen foods may significantly increase the count per gram for the food. Waters used to cool heat-sterilized cans or jars of food must be low in total count for bacteria to prevent serious spoilage due to aspiration of organisms through container seams. Chlorination is widely practised to assure low bacterial counts on container cooling waters.

## WATER QUALITY CRITERIA FOR THE ELECTROPLATING AND METAL FINISHING INDUSTRIES — IWS-5

Plating-room processes that utilize water include the stripping or pickling operations, cleaning by organic solvents or alkaline solutions, rinsing, and electrochemical plating. For acid stripping or for alkaline cleaning, the quality of water used in the baths is seldom critical, for the added chemicals far outweigh the natural constituents of the water. Hardness of water may be detrimental when soaps or alkaline cleaning agents are used.

For rinsing and for plating, water quality is frequently a major problem. High quality water is of primary importance to assure satisfactory finished work. For decorative plating, water spots and stains may necessitate reworking, wiping, buffing, and other laborious operations. Before the application of any organic corrosion-resistant coating, it is almost a necessity to use demineralized water in the final rinse, in order to achieve adhesion of the coating. A high concentration of dissolved solids is especially detrimental in rinse waters.

In plating baths, iron, aluminum, calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulphide, sulphite, sulphate, fluoride, chloride, silicate, copper, and lead have been reported to cause difficulties under certain conditions. Considerable evaporation occurs from plating baths and hence the ions present in the make-up water are concentrated to the extent that they are troublesome.

Calcium and magnesium are especially troublesome in plating baths, for they tend to precipitate to form scale on the heated surface or a sludge in the water. There is a probability of these precipitates being included in the electro-deposit, causing pits, porosity, and roughness. Magnesium may also reduce the "throwing power" in chromium baths, but on the other hand, magnesium sulphate is sometimes added to nickel-plating baths to produce softer deposits, to minimize certain types of pitting, and to increase throwing power.

Sodium and potassium are generally not harmful in plating operations, although sodium may cause brittle deposits in nickel baths or reduce the throwing power in chromium solutions. Iron is one of the most troublesome pollutants of many plating operations. In a nickel-sulphate bath, it may cause hazy, streaked, pitted, or brittle deposits; in acid copper solutions, it produces rough deposits; in chromium baths, it reduces the throwing power; in

cadmium cyanide, it causes hazy deposits; in silver cyanide, stained deposits; and in zinc sulphate baths it lowers the plating efficiency and the protective value of the coating.

Among the anions, bicarbonates are detrimental in heated alkaline baths, for they tend to be converted to carbonates and accelerate the precipitation of calcium. Moreover, they buffer the water and require higher dosages of acid or alkali to obtain the desired pH value. Chlorides have been reported to cause rough, modular, iridescent, and crystalline deposits in cadmium, copper, silver, and tin baths respectively. Organic substances reduce chromium, and cause rough, hazy, streaked, coloured, or pitted deposits under various conditions. Colour and turbidity are similarly objectionable.

Abstracted from "Water Quality Criteria", 2nd Edition, State Water Quality Control Board, California, Publication No. 3-A

**TABLE IWS-6**

**WATER QUALITY CRITERIA FOR THE IRON AND STEEL INDUSTRY**

(Unless otherwise indicated, units are mg/l)

| Characteristic | Quenching, hot rolling, gas cleaning | Cold rolling | Selected rinse waters | |
|---|---|---|---|---|
| | | | Softened | Demineralized |
| Suspended solids | 25 | 10 | (2) | (2) |
| Dissolved solids | (1) | (1) | (1) | (2) |
| Alkalinity ($CaCO_3$) | (3) | (3) | (3) | (2) |
| Hardness ($CaCO_3$) | (3) | (3) | 100 | (2) |
| pH, units | 6.0-9.0 | 6.0-9.0 | 6.0-9.0 | (3) |
| Chloride (Cl) | 150 | 150 | 150 | (2) |
| Dissolved oxygen ($O_2$) | (4) | (4) | (4) | (4) |
| Temperature, °F | 100 | 100 | 100 | 100 |
| Oil | (1) | (2) | (2) | (2) |
| Floating material | (1) | (2) | (2) | (2) |

(1) Accepted as received if meeting total solids or other limiting values.

(2) Zero, not detectable by test.

(3) Controlled by treatment for other constituents.

(4) Minimum to maintain aerobic conditions.

## TABLE IWS-7

## WATER QUALITY CRITERIA FOR THE PETROLEUM INDUSTRY

(Unless otherwise indicated, units are mg/l)

| Characteristic | Concentration |
|---|---|
| Silica ($SiO_2$) | (1) |
| Iron (Fe) | 1 |
| Calcium (Ca) | 75 |
| Magnesium (Mg) | 25 |
| Bicarbonate ($HCO_3$) | (1) |
| Sulphate ($SO_4$) | (1) |
| Chloride (Cl) | 200 |
| Fluoride (F) | (1) |
| Nitrate ($NO_3$) as N | (1) |
| Dissolved solids | 750 |
| Suspended solids | 10 |
| Hardness ($CaCO_3$) | 350 |
| Noncarbonate hardness ($CaCO_3$) | 70 |
| Colour, units | (1) |
| pH, units | 6.0-9.0 |

(1) Accepted as received if meeting total solids or other limiting values.

## TABLE IWS-8

## WATER QUALITY CRITERIA FOR THE PULP AND PAPER INDUSTRY

(Unless otherwise indicated, units are mg/l)

| | | Chemical Pulp and Paper | |
|---|---|---|---|
| Characteristic | Mechanical Pulping | Unbleached | Bleached |
| Silica ($SiO_2$) | (1) | 50 | 50 |
| Aluminum (Al) | (1) | (1) | (1) |
| Iron (Fe) | 0.3 | 1.0 | 0.1 |
| Manganese (Mn) | 0.1 | 0.1 | 0.05 |
| Zinc (Zn) | (1) | (1) | (1) |
| Calcium (Ca) | (1) | 20 | 20 |
| Magnesium (Mg) | (1) | 10 | 10 |
| Sulphate ($SO_4$) | (1) | (1) | (1) |
| Chloride (Cl) | 500 | 200 | 200 |
| Dissolved solids | (1) | (1) | (1) |
| Suspended solids | (1) | 10(2) | 10(2) |
| Hardness ($CaCO_3$) | (1) | 100 | 100 |
| pH, units | 6.0-9.0 | 6.0-9.0 | 6.0-9.0 |
| Colour, units | 30 | 30 | 10 |
| Temperature, °F | (1) | (1) | 95 |

(1) Accepted as received if meeting total solids or other limiting values.

(2) No gritty or colour-producing solids.

## TABLE IWS-9

### WATER QUALITY CRITERIA FOR THE LEATHER TANNING AND FINISHING INDUSTRY

(Unless otherwise indicated, units are mg/l)

| Characteristic | Tanning Processes | General Finishing Processes | Colouring |
|---|---|---|---|
| Alkalinity ($CaCO_3$) | (1) | 130 | 130 |
| pH, units | 6.0-8.0 | 6.0-8.0 | 6.0-8.0 |
| Hardness ($CaCO_3$) | 150 | (2) | (3, 4) |
| Calcium (Ca) | 60 | (2) | (3, 4) |
| Chloride (Cl) | 250 | 250 | (5) |
| Sulphate ($SO_4$) | 250 | 250 | (5) |
| Iron (Fe) | 0.3 | 0.3 | 0.1 |
| Manganese (Mn) | 0.2 | 0.2 | 0.01 |
| Organics: | | | |
| Carbon chloroform extract (CCE) | (5) | 0.2 | (3) |
| Colour, units | 5 | 5 | 5 |
| Coliform bacteria, count/100 ml | (6) | (6) | (5) |
| Turbidity | (3) | (3) | (3) |

(1) Accepted as received if meeting total solids or other limiting values.
(2) Lime softened.
(3) Zero, not detectable by test.
(4) Demineralized or distilled water.
(5) Concentration not known.
(6) OWRC Drinking Water Objectives.

## TABLE IWS-10

### WATER QUALITY CRITERIA FOR THE TEXTILE INDUSTRY

(Unless otherwise indicated, units are mg/l)

| Characteristic | Sizing Suspension | Scouring | Bleaching | Dyeing |
|---|---|---|---|---|
| Iron (Fe) | 0.3 | 0.1 | 0.1 | 0.1 |
| Manganese (Mn) | 0.05 | 0.01 | 0.01 | 0.01 |
| Copper (Cu) | 0.05 | 0.01 | 0.01 | 0.01 |
| Dissolved solids | 100 | 100 | 100 | 100 |
| Suspended solids | 5 | 5 | 5 | 5 |
| Hardness ($CaCO_3$) | 25 | 25 | 25 | 25 |
| pH, units: | | | | |
| Cotton | 6.5-10.0 | 9.0-10.5 | 2.5-10.5 | 7.5-10.0 |
| Synthetics | 6.5-10.0 | 3.0-10.5 | (1) | 6.5-7.5 |
| Wool | 6.5-10.0 | 3.0-5.0 | 2.5-5.0 | 3.5-6.0 |
| Colour, units | 5 | 5 | 5 | 5 |

(1) Not applicable.

## 4 CRITERIA FOR PUBLIC WATER SUPPLIES (PWS)

Criteria are given for public and private supplies from both surface and ground water sources.

Public supplies include water systems operated by municipalities, public utilities, industries, commissions, commercial establishments, etc. where competent operation of the water supply system is provided.

Private supplies include water systems operated by personnel who may not have the necessary technical or mechanical expertise.

### PWS-1 Criteria for Public Surface Water Supplies

Since treatment processes exist which can convert any raw water (with a few minor exceptions) to potable water, it is necessary to define a commonly accepted treatment system which can produce a potable water at a reasonable cost. For the purposes of these criteria, such a system has been defined to consist of coagulation, flocculation, sedimentation and rapid sand filtration; the use of chemicals is restricted by definition to the commonly used coagulants and chlorine for disinfection.

Two types of criteria have been established, namely the Permissible Criteria and the Desirable Criteria (Table PWS-1). Waters meeting both of these criteria are acceptable for treatment by the defined treatment process stated above. Waters meeting the Desirable Criteria provide for a greater margin of safety.

It should be borne in mind that the values given under the Permissible Criteria cannot be considered as maximum single sample values. These criteria should not be exceeded over substantial portions of time. If this should occur, then it will become necessary to determine the cause and initiate corrective action. The frequency and variety of sampling should be based on the findings of a comprehensive pollution survey.

TABLE PWS-1

WATER QUALITY CRITERIA FOR
PUBLIC SURFACE WATER SUPPLIES

(Unless otherwise indicated, units are mg/l)

| Constituent or Characteristic | Permissible Criteria | Desirable Criteria |
|---|---|---|
| **Physical** | | |
| Colour (platinum-cobalt) | 75 units | < 5 units |
| Odour | Readily removable by defined treatment | Absent |
| Turbidity | — do — | Absent |
| Temperature | 85°F | Pleasant tasting |
| **Inorganic Chemicals** | | |
| Ammonia | 0.5 (as N) | < 0.01 |
| Arsenic* | 0.05 | Absent |
| Barium* | 1.0 | Absent |
| Boron* | 1.0 | Absent |
| Cadmium* | 0.01 | Absent |
| Chloride* | 250 | < 25 |
| Chromium* (hexavalent) | 0.05 | Absent |
| Copper* | 1.0 | Virtually absent |
| Dissolved Oxygen | ≥ 4 (monthly mean)<br>≥ 3 (individual sample) | Near saturation |
| Fluoride* | See footnote (1) | 1.0 |
| Hardness* | Acceptable levels will vary with local hydrogeologic conditions and consumer acceptance. | |
| Iron (filterable) | 0.3 | Virtually absent |
| Lead* | 0.05 | Absent |
| Manganese* (filterable) | 0.05 | Absent |
| Nitrate plus Nitrite* | 10 (as N) | Virtually absent |
| pH range | 6.0 - 8.5 units | Least amount of interference with treatment process |
| Phosphorus* (phosphates) | Not encourage growth of algae or interfere with treatment process | |
| Selenium* | 0.01 | Absent |
| Silver* | 0.05 | Absent |
| Sulphate* | 250 | < 50 |
| Total Dissolved Solids* (filterable residue) | 500 | < 200 |
| Uranyl Ion* | 5 | Absent |
| Zinc* | 5 | Virtually absent |
| **Organic Chemicals(2)** | | |
| Carbon chloroform extract* (CCE) | 0.15 | < 0.04 |
| Cyanide* | 0.20 | Absent |
| Methylene blue active substances* | 0.5 | Virtually absent |
| Oil and grease* | Virtually absent | Absent |

Table PWS-1 (cont.)

| Constituent or Characteristic | Permissible Criteria | Desirable Criteria |
|---|---|---|
| Pesticides: | | |
| Aldrin* | 0.017 | — do — |
| Chlordane* | 0.003 | — do — |
| DDT* | 0.042 | — do — |
| Dieldrin* | 0.017 | — do — |
| Endrin* | 0.001 | — do — |
| Heptachlor* | 0.018 | — do — |
| Heptachlor epoxide* | 0.018 | — do — |
| Lindane* | 0.056 | — do — |
| Methoxychlor* | 0.035 | — do — |
| Organic phosphates plus carbamates* | 0.1 | — do — |
| Toxaphene* | 0.005 | — do — |
| Herbicides: | | |
| 2,4-D plus 2,4,5-T, plus 2,4,5-TP* | 0.1 | — do — |
| Phenolic Substances* | Virtually absent | — do — |
| **Radioactivity** | (pc/l) | (pc/l) |
| Gross beta* | 1,000 | < 100 |
| Radium-226* | 3 | < 1 |
| Strontium-90* | 10 | < 2 |
| **Microbiological** (3) | | |
| Coliform organisms (at 35°C) | 5,000/100 ml | < 100/100 ml |
| Fecal coliforms (44.5°C) | 500/100 ml | < 10/100 ml |
| Fecal streptococci (35°C) | 50/100 ml | < 1/100 ml |
| Total Bacteria (20°C) | 100,000/100 ml | < 1,000/100 ml |
| Clostridia (in water) (35°C) | 50/100 ml | 0/100 ml |

* The defined treatment process has little effect on the constituents.

(1)

| Annual Avg. of Max. Daily Air Temp. F. | Recommended Limit for Fluoride mg/l |
|---|---|
| 50.0 to 53.7 | 1.7 |
| 53.8 to 58.3 | 1.5 |
| 58.4 to 63.8 | 1.3 |

(2) Organic chemicals should not be present in concentrations as to cause adverse tastes and odours which cannot be removed by the defined treatment and/or by chlorination only.

(3) A monthly geometric mean of the results of raw water samples collected on a weekly basis (minimum of one sample per week) should be less than the numbers given under the Permissible Criteria column. These figures do not imply a relationship between bacterial groups.

**PWS-2 Criteria for Public Ground Water Supplies**

With the exception of dissolved oxygen, fluorides and microbiological criteria, the water quality criteria for surface water apply to ground water supplies.

For fluorides, hydrogen sulphide and pollution indicator organisms, the following apply to ground water supplies:

| | Permissible Criteria | Desirable Criteria |
|---|---|---|
| | (Unless otherwise indicated, units are mg/l) | |
| Fluoride | 2.4 | 1.0 |
| Hydrogen Sulphide | 0.1 | Absent |
| Pollution Indicator Organisms | Coliform and other pollution indicator organisms should be virtually absent from all ground water supplies. | |

It is considered desirable to provide the maximum of treatment — chlorination — for all ground water supplies. This measure ensures that nuisance organisms which exist in virtually all waters do not get the opportunity to develop a foothold in a water distribution system and thereby create objectionable conditions.

**PWS-3 Criteria for Private Water Supplies**

The raw water available to private supplies such as individual dwellings, cottages, farms, etc., must be of such quality that it can be used in the raw state or be made acceptable for use with a minimum of treatment limited to disinfection, filtration and/or softening. Economic considerations and lack of technical/mechanical expertise will prohibit the use of raw water supplies that require extensive treatment.

Some surface supplies have turbidities, colour and other undesirable constituents in excess of what can be used effectively in home or farm operations. Some ground water supplies (wells and springs) harbour objectionable gases, nuisance bacteria, in addition to having high concentrations of iron and being highly mineralized. The initial approach in establishing a private water supply should be to explore the ground water potential from the aspects of both quality and quantity. In many instances, deficiencies in ground water quality can be offset at a relatively low cost compared to that for surface waters.

Criteria for private water supplies are identical to the surface water criteria for public water supplies, with the exception of fluorides, hydrogen sulphide, physical and microbiological characteristics. For fluorides and hydrogen sulphide, the applicable criteria appear in Section PWS-2.

**Physical Criteria:**

The water supply should be substantially free from substances offensive to sight, taste or smell. Threshold odour values in excess of three units are generally considered objectionable.

Colour in the water supply should not exceed 15 units (platinum-cobalt scale).

Turbidity should be less than five units. Turbidities of up to 20 units may be removed relatively easily by sand or diatomaceous earth filters.

**Microbiological Criteria:**

| Microorganisms | Permissible Criteria | | Desirable Criteria |
|---|---|---|---|
| | Chlorination only | Chlorination & Filtration | No Treatment |
| Coliforms (35°C) | 100/100 ml | 400/100 ml | 0/100 ml |
| Fecal Coliforms (44.5°C) | 10/100 ml | 40/100 ml | 0/100 ml |
| Enterococci (35°C) | 1/100 ml | 4/100 ml | 0/100 ml |
| Total Bacteria (20°C) | 1000/100 ml | 4000/100 ml | 10/100 ml |
| Clostridia (in water) (35°C) | 0/100 ml | 4/100 ml | 0/100 ml |

Raw water samples should be collected at least monthly. The Geometric Mean of sample results should not exceed the values given in the table above.

## 5 CRITERIA OF WATER QUALITY FOR AESTHETICS AND RECREATION (A & R)

All surface waters should be capable of supporting life forms of aesthetic value. The positive aesthetic and recreational values of water should be attained through continuous enhancement of water quality. Surface waters should be of such quality as to provide for the enjoyment of recreational activities such as hunting and fishing which are based on the utilization or consumption of fish, waterfowl and other forms of life.

The aesthetic and recreational values of unique or outstanding waters should be recognized and protected by development of appropriate water quality standards for each individual case. To retain or establish unspoiled wilderness values, it may be necessary to control access by mechanized methods of transportation.

General criteria for recreation and aesthetic use and specific criteria for total body contact recreation follow:

### A & R-1 General Criteria for Recreation and Aesthetics

Surface waters should be free of substances attributable to discharge of waste or land drainage which may impair aesthetic or recreational use, as follows:

(1) Materials that will settle to form objectionable deposits.

(2) Floating debris, oil, scum and other matter.

(3) Substances producing objectionable colour, odour, taste or turbidity.

(4) Materials, including radionuclides, in concentrations or combinations which are toxic or which produce undesirable physiological responses in humans, fish and other life and plants.

(5) Substances, including nutrients, and conditions, including temperature, or combinations thereof in a degree or concentration which produces undesirable types or abundance of aquatic life.

### A & R-2 Criteria for Total Body Contact Recreation

Surface waters for total body contact recreational use should be free of substances attributable to discharge of waste or land drainage as follows:

(1) Materials which will cause the pH to change beyond the range 6.5-8.3.

(2) Materials which will obscure visibility in the water. In designated swimming and diving areas, clarity should be such that a Secchi Disc on the bottom is visible from the surface.

(3) Conditions which will cause the water temperature to exceed 85°F.

(4) Microbiological Criteria
Water used for body contact recreational activities should be free from pathogens including any bacteria, fungi or viruses that may produce enteric disorders or eye, ear, nose, throat and skin infections. Where ingestion is probable, recreational waters can be considered impaired when the coliform, fecal coliform, and/or enterococcus geometric mean density exceeds 1000, 100 and/or 20 per 100 ml respectively, in a series of at least ten samples per month, including samples collected during weekend periods.

If these criteria are exceeded, it will become necessary to determine the cause and initiate corrective action.

When evaluating a given area of water for recreational use, the appropriate numbers of samples, and the choice of tests to be performed should be determined by consultation between sampler and analyst, prior to sampling. An effort should be made to increase utilization of the fecal coliform and enterococcus tests since these presently appear to be the more relevant guides to the bacterial quality of bathing waters.

## GLOSSARY OF TERMS

| | |
|---|---|
| Bioassay | — A controlled laboratory procedure which subjects live aquatic organisms to various environmental stresses. |
| Effluent Requirements | — Numerical or verbal descriptions of the quality of a waste or drainage effluent at the point of discharge to a receiving water body, land disposal site or waste disposal well. |
| Eutrophication | — The increase in the nutrient content of the natural waters of a lake or other body of water. |
| Geometric Mean | — The nth root of the product of n observations. The equation for the geometric mean ($G_x$) can be expressed as: $G_x = \sqrt[n]{X_1 . X_2 . X_3 . \ldots\ldots\ldots\ldots X_n}$ or $G_x = \text{antilog}\left(\frac{\log X_1 + \log X_2 + \ldots . \log X_n}{n}\right)$ |
| Land Drainage | — Water that has drained from the land surface naturally or through man-made drainage systems. |
| Milligrams per Litre (mg/l) | — A unit of measure expressing the concentration of a substance in a solution. |
| Milligram equivalents per litre (mg. eq/l) | — A unit indicating the chemical equivalence of ions; derived by dividing the concentration of an ion in milligrams per litre by the combining weight of that ion. Note: combining weight $= \frac{\text{atomic or molecular weight of ion}}{\text{ionic charge}}$ |
| Oligotrophic | — Waters with a small supply of nutrients and hence a small organic production; usually having abundant dissolved oxygen at all depths. |
| Photosnythetic (adj.) | — Relating to the process by which the chlorophyl-bearing cells of green plants convert carbon dioxide ($CO_2$) and water ($H_2O$) into sugar ($C_6H_{12}O_6$) and oxygen ($O_2$) in the presence of light. |
| Raw Water | — Surface or ground water, prior to treatment. |
| Waste | — Liquid carrying unwanted materials or compounds resulting from human activities or enterprises to a point of discharge. The mixture may or may not have received treatment. |
| Water Quality Criteria | — Numerical or verbal descriptions of the quality of water required for particular uses. |
| Water Quality Standards | — Numerical or verbal descriptions of the quality of water required for a variety of uses in a given drainage system. |

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